

**Curriculum
for the Undergraduate Program
Session: 2023-2024**



**DEPARTMENT OF STATISTICS
SCHOOL OF PHYSICAL SCIENCES
SHAHJALAL UNIVERSITY OF
SCIENCE AND TECHNOLOGY, SYLHET**

Faculty list

Sl No.	Full Name	
	Head	
1.	Professor Dr. Mohammed Taj Uddin	01716348194
	Professors	
2.	Dr. Md. Kabir Hossain*	01711184818
3.	Dr. Md. Zakir Hossain	01711140801
4.	Dr. Sabina Islam	01911720525
5.	Dr. Ahmad Kabir	01711116908
6.	Mr. Md. Ahmed Kabir Chowdhury	01714227456
7.	Dr. Rahmat Ali	01778266418
8.	Dr. Md. Azizul Baten	01716262947
9.	Dr. Mohammed Taj Uddin	01716348194
10.	Dr. Mohammad Shahidul Islam*	01777827876
11.	Dr. Md. Nazrul Islam	01711466280
12.	Dr. Mohammad Ohid Ullah	01818101435
13.	Dr. S. M. Khurshid Alam	01716090465
14.	Dr. Khalidur Rahman	01712068785
15.	Dr. Md. Jamal Uddin	01716972846
16.	Dr. Luthful Alahi Kawsar	01711318223
17.	Dr. Mossamet Kamrun Nesa*	01796747485
18.	Dr. Mohammad Romel Bhuiya	01782728082
	Associate Professors	
19.	Dr. Mirza Nazmul Hasan	01767013458
20.	Dr. Kanis Fatama Ferdushi	01818824338
	Assistant Professors	
21.	Mrs. Nahid Sultana	01728707307
22.	Dr. Mohammad Anamul Haque	01716563263
	Lecturers	
23.	Mr. Abdullah Al Islam	01521236258
24.	Mrs. Israt Jahan	01706880947

Description of the Department

Shahjalal University of Science and Technology (SUST) is the first science and technology university in Bangladesh and many of its departments are at the national and international forefront of education and research in various fields. The Department of Statistics at SUST, which began its academic journey in 1991, is one of the pioneer departments of the university. It is one of the largest concentrations of statistical education and research with 23 faculties and 257 undergraduate and 50 graduate students. Among the faculty members, there are 17 Professors, 2 Associate Professors, 2 Assistant Professors and 2 Lecturers. Along with a wide range of contemporary and demand-driven courses in undergraduate and graduate levels, the department also offers M.Phil. and Ph.D. programs. The department has already produced 5 PhD, 3 M.Phil, 783 M.S. graduates, and 1069 B.Sc. (Honours) graduates. Every year average number of intakes in undergraduate level is 80 and 40 in graduate program. Currently 5 Ph.D. students are pursuing research in the department towards achieving their goals. The department has two computer laboratories equipped with more than 140 computers under complete network coverage and internet facility. Students enjoy working with state of the art statistical and other related software. We have a well-organized seminar library with sufficient books, journals, periodicals and other publications. Our faculties and students are regularly publishing their research works in scientific peer reviewed national and international journals and in book chapters. The Department has an association, named ‘Parishankhyan Paribar’, which is the central banner for organizing all extra-curricular activities of the department, such as cultural programs, games and sports, picnic etc. This department received grants from many projects, most notably two Higher Education Quality Enhancement Project (HEQEP) – one in collaboration with the Department of Mathematics and the other by the entity itself for infrastructural development. The Department of Statistics regularly organizes seminars and workshops on contemporary research issues which helps faculty members become updated on cutting-edge topics by sharing knowledge and views, and make students acquaint with research in the subject.

Employment opportunities for our graduates are excellent. Our students find careers in research organizations, diverse government sectors, public and private universities, commercial banks and financial institutions, central bank (Bangladesh Bank), insurance companies, UN associate organizations, national and international NGOs,

reputed national and multinational companies, and other academic institutions in home and abroad. Moreover, every year a notable number of students get admission to reputed foreign universities for higher studies with financial supports.

Part A

1. Title of the Academic Program:	Undergraduate Program
2. Name of the University:	Shahjalal University of Science and Technology, Sylhet.
3. Vision of the University:	To be a leading university of excellence in Science and Technology with a strong national commitment and significant international impact.
4 Mission of the University:	UM1: To advance learning and knowledge through teaching and research in science and technology UM2: To serve as a center for knowledge creation, technological innovation and transfer among academia, industry, and society UM3: To assist in transferring Bangladesh a country with sustainable economic growth and equitable social development
5. Name of the Program Offering Entity:	Department of Statistics
6. Vision of the Department:	Evolving expertise in statistics to serve nationally and internationally
7. Mission of the Department:	M1: Achieve excellence and expansion of knowledge in statistics as well as in data science M2: Maintain the quality of teaching and research at international standard M3: Collaborate with stakeholders for planning, statistical analysis and research

M4: Promote and tailor research for taking appropriate decision to achieve development goals of the country

8. Objectives of the Department:

- i.** Disseminate fundamental and advance statistical knowledge to adopt and validate data analysis technique
- ii.** Contribute to the theoretical and practical development of statistical methods addressing substantive problems
- iii.** Organizing workshops, seminars, conferences with stakeholders to improve quality of research and implement the statistical techniques
- iv.** Provide adequate and relevant guidelines of statistics to make planning and decision for achieving Sustainable Development Goals in Bangladesh

9. Name of the Degree: Bachelor of Science (Honours) in Statistics

10. Description of the Program:

Shahjalal University of Science and Technology (SUST), Sylhet was established in 1986. It is the first science and technology university in Bangladesh. The Department of Statistics at SUST, under the school of physical sciences, is one of the pioneer departments of the university, established in 1990. Its academic function started from 1991 with the undergraduate program: Bachelor of Science (B.Sc.) with Honours in Statistics. On average 80 students admitted into the program every academic year by the undergraduate admission committee of SUST. The department has produced 1069 B.Sc. (Honours) graduates until 2022-2023. Many of them are now employed as university faculties, researchers, and other high-profile service jobs in home and abroad. In addition to that, a large number of graduates get admission with scholarships to reputed foreign universities for higher studies in each year.

The department conducts academic activities based on a syllabus structure until

the 2019–2020 academic year in accordance with university regulations. The Outcome Based Education (OBE) curriculum applies to students commencing the program as from session 2020-2021. After necessary correction, the department has developed OBE curriculum for the current session (2023-2024) following ‘Bangladesh National Qualifications Framework (BNQF) for Higher Education’ and ‘Semester System Ordinance’ of the university under the guidance of Institutional Quality Assurance Cell (IQAC), SUST. In the current session, the program consists of eight semesters and the courses of each semester are arranged according to the International Standard Classification of Education (Source: ISCED-F 2013, UNESCO, Institute of Statistics: Canada: Montreal). The courses are divided into Core, General Education, Elective or Optional courses. The program includes English, Database Management & Programming, Micro and macro-economics, Mathematics as a part of general education courses along with the core courses. The required credits for obtaining the degree is 145. The goal of the program is to create graduates with the newly introduced OBE curriculum so that they can solve new challenges emerge nationally and internationally.

11. Graduate Attributes (based on need assessment):

Code	Graduate Attributes	Domain
GA 01	In-depth statistical knowledge and professional skills	Fundamental skills
GA 02	Beyond-discipline knowledge, insight and skills	Fundamental skills
GA 03	Awareness of and sensitivity to ethics and ethical standard on interpersonal, social, research, and professional levels	Social skills
GA 04	Valuing integrity, environmental sustainability, and civic engagement	Social skills
GA 05	Capacity for critical, creative, and evidence-based thinking to solve complex problems	Thinking skills
GA 06	Engage in professional behavior and have the potential to take leadership roles in their chosen careers and communities	Thinking skills
GA 07	Capacity for self-reflection, self-discovery, and personal development	Personal skills
GA 08	Capable of communicating effectively in a range of	Personal skills

	contexts including digital capabilities	
12. Program Educational Objectives (PEOs)		
PEO1	To provide in-depth knowledge of descriptive and inferential statistics	
PEO2	To promote creative thinking for exploring and analyzing different kinds of data produced from various disciplines	
PEO3	To boost up a spirit of enquiry searching for facts and truths by developing statistical tools that supports critical analysis and decision making	
PEO4	To help students comprehend the roles of statistics in science and engineering especially industrial, environmental, social, biomedical, epidemiological, agricultural, biological and economical aspects nationally as well as internationally	
PEO5	To acquaint students with a spirit of ethics and social commitment in the personal and professional life to add value to the society in national and international levels	

13. Program Learning Outcomes (POs):

After successful completion of the program, the graduates are expected to come up with the ability to-

A. Fundamental Skills	
PO1	Explain acquired knowledge of statistical theories and practices along with other allied subjects.
PO2	Prepare study designs and implement them through data collection, analysis, and disseminate the findings to potential stakeholders.
B. Social Skills	
PO3	Demonstrate statistical knowledge embedded with ethics and sense of social commitment for value creation to society, and collaborate with multi-disciplinary groups.
C. Thinking Skills	
PO4	Demonstrate analytical abilities and critical thinking to make data-driven decisions using statistical techniques.
D. Personal Skills	
PO5	Conduct research independently as well as in a team and communicate effectively with stakeholders.
PO6	Prepare a roadmap for future career.

14. Mapping mission of the university with PEOs

PEOs	UM 1	UM 2	UM 3
PEO 1	√	√	
PEO 2		√	
PEO 3	√		
PEO 4		√	√
PEO 5		√	√

15. Mapping POs with the PEOs

	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
PO 1	√	√			
PO 2	√	√		√	
PO 3	√				√
PO 4	√	√		√	
PO 5		√	√		√
PO 6				√	√

16. Mapping courses with the Pos

Courses	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
STA 0542 1151	√	√				
STA 0542 1152	√	√				
MAT 0541 1103	√			√		
ENG 0231 1105		√	√		√	
SSS 0222 1107			√			√
STA 0542 1150	√				√	√
STA 0542 1251	√	√		√		
STA 0542 1253	√	√				
STA 0542 1254	√	√				
STA 0542 1256		√		√	√	√
MAT 0541 1205	√			√		
MAT 0541 1207	√			√		
ENG 0231 1209	√		√		√	√
STA 0542 1250	√				√	√

STA 0542 2151	√					
STA 0542 2153	√	√	√			
STA 0542 2154	√	√	√			
STA 0542 2156	√	√		√	√	√
MAT 0541 2105	√			√		
ECO 0311 2107	√		√		√	
STA 0542 2150	√				√	√
STA 0542 2251	√		√	√	√	
STA 0542 2252	√					
MAT 0541 2203	√			√		
MAT 0541 2205	√			√		
ECO 0311 2207	√		√		√	
CSE 0612 2209	√	√	√			
CSE 0612 2211	√	√	√			
STA 0542 2250	√				√	√
STA 0542 3151	√	√		√	√	
STA 0542 3152	√	√			√	
STA 0542 3153	√	√		√		
STA 0542 3154	√	√		√	√	
STA 0542 3155		√		√	√	√
STA 0542 3156		√		√	√	√
STA 0542 3157		√		√	√	√
STA 0542 3150	√				√	√
STA 0542 3251	√		√	√	√	
STA 0542 3252	√		√	√	√	
STA 0314 3253	√		√	√	√	
STA 0314 3254		√		√	√	√
STA 0542 3255		√		√	√	√
STA 0542 3256		√		√	√	√
STA 0542 3257	√	√		√	√	
STA 0542 3258	√	√		√	√	
STA 0542 3259		√	√	√	√	√
STA 0542 3250	√				√	√

STA 0542 4151		√	√	√	√	
STA 0542 4152		√	√	√	√	
STA 0542 4153	√	√	√	√		
STA 0542 4154	√	√	√	√		
STA 0542 4155	√	√		√	√	
STA 0542 4156	√	√		√	√	
STA 0542 4157	√	√	√	√		
STA 0542 4158	√	√	√	√		
STA 0542 4150	√		√		√	√
STA 0542 4251	√			√		
STA 0542 4252	√	√		√		
STA 0542 4253	√	√	√	√		
STA 0542 4254		√	√	√	√	
STA 0542 4255	√	√		√	√	
STA 0542 4257		√	√	√	√	√
STA 0542 4258	√	√	√	√	√	√
STA 0542 4259	√	√		√		
STA 0542 4250	√		√		√	√

STA: Statistics; GED: General Education; SPS: School of Physical Sciences; 0542 indicates Statistical courses

Part B
17. Structure of the Curriculum

- a) Duration of the Program: Years: 4 Semesters: 8
- b) Admission Requirements:

<p>The admission committee of the university will conduct the admission process for the Bachelor’s degree as per the rules. The student will enroll in the first semester of an academic year in individual disciplines of different schools. The admission of foreign students will be subjected to the</p>	<p>For admissions to higher semester (2nd to 10th) and course registration following requisites and steps have to be strictly maintained:</p> <p>(1) Completion of 100 level courses is mandatory for student’s admission in semester of 300 level courses.</p> <p>(2) Completion of 200 level courses is required for admission in semester of 400 level courses.</p>
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<p>verification of academic records as per the university rule.</p> <p>Every student has to maintain her/his student status by enrolling, paying tuition fees, and doing the registration for required credits every successive semester following the requirements (Section-4 of Ordinance for Semester System for Bachelor’s Degree).</p> <p>Re-admission: A student will be eligible for re-admission in the first year first semester of the subsequent session if s/he was present in at least 25% of the classes of her/his core and elective courses of the same semester.</p> <p>A student has to take re-admission if her/his student status is not maintained or one or more semesters have annulled because of disciplinary action taken against him/her. In the case of semester annulment, the student has to re-admit the same level of semester. The level (Year and Semester) of re-admitter will be determined by his/ her completed credits. The re-admitted students will always be assigned the original Registration number.</p>	<p>(3) A student having incomplete 100 level courses shall be allowed for admission in her/his next available semester of 100-200 level courses until s/he completes all of 100 level courses.</p> <p>(4) A student having incomplete 200 level courses shall be allowed for admission in her/his next available semester of 200-300 level courses until s/he completes all of 200 level courses.</p> <p>(5) Once a student reaches to 8th/10th semester of 4/5 years’ program s/he will be kept at this level, if necessary, till the specified last semester of the undergraduate program for completion of credit requirement of graduation.</p> <p>Every admission/course registration of a student will be counted and adjusted from the total number of semesters of the program to determine her/his remaining period of study. Student advisors of all disciplines will advise every student about her/his courses for registration and monitor her/his performances. Accordingly, a student has to register for her/his courses and pay necessary dues within the first 4 (Four) weeks of every semester (2 more weeks for late registration). A student will not be allowed to appear in the examination if her/his semester and examination fee is not fully paid off. Foreign student must have valid Visa/residential permit to appear in the examination and that has to be checked by the student advisor and the head of the discipline/institute.</p>
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c) Graduating credits: 145 (Without any Optional/Elective Course)
d) Total class weeks in a semester: 14
e) Minimum CGPA requirement for graduation: 2.0
f) Maximum academic years of completion: 6
g) Category of Courses:

Course Category	Course Type	Course Title	Credits
General Education (GED) Courses	Theory	1. Basic Algebra	3.0
		2. English Language	2.0
		3. History of the Emergence of Independent Bangladesh	3.0
		4. Calculus	3.0
		5. Linear Algebra	3.0
		6. Academic Writing	2.0
		7. Advanced Calculus & Differential Equations	3.0
		8. Principles of Microeconomics	3.0
		9. Numerical Methods	3.0
		10. Real Analysis	3.0
		11. Principles of Macroeconomics	3.0
		12. Database Management & Programming	2.0
	Lab	1. Database Management & Programming Lab	3.0
		Total	36.0 Credits
Core Courses	Theory	1. Principles of Statistics	3.0
		2. Introduction to Probability	3.0
		3. Sampling Techniques – I	3.0
		4. Probability Distributions	3.0
		5. Theory of Statistics	3.0
		6. Regression Analysis – I	3.0
		7. Design & Analysis of Experiments –I	3.0
		8. Statistical Inference	3.0
		9. Statistical Simulation and Data	2.0

		Analysis with R & Python	
		10. Linear Programming	3.0
		11. Stochastic Processes	3.0
		12. Demography	3.0
		13. Regression Analysis – II	3.0
		14. Economic Statistics	3.0
		15. Applied Statistics	3.0
		16. Design & Analysis of Experiments – II	3.0
		17. Sampling Techniques – II	3.0
		18. Multivariate Analysis	3.0
		19. Biostatistics and Epidemiology	3.0
		20. Generalized Linear Models	2.0
		21. Introduction to Data Science	2.0
		22. Research Methodology	2.0
Lab		1. Principles of Statistics Lab	2.0
		2. Sampling Techniques – I Lab	2.0
		3. Introduction to Computer and SPSS Lab	1.5
		4. Theory of Statistics Lab	2.0
		5. Statistical Computing: C++ & STATA Lab	1.5
		6. Regression Analysis – I Lab	1.5
		7. Design & Analysis of Experiments – I Lab	2.0
		8. Statistical Inference Lab	2.0
		9. Statistical Simulation and Data Analysis with R & Python Lab	1.5
		10. Stochastic Processes Lab	2.0
		11. Demography Lab	2.0
		12. Data Analysis with SAS Lab	1.5
		13. Regression Analysis – II Lab	2.0
		14. Economic Statistics Lab	2.0
		15. Applied Statistics Lab	1.5
		16. Design & Analysis of Experiments –	2.0

		II Lab	
		17. Sampling Techniques – II Lab	2.0
		18. Multivariate Analysis Lab	2.0
		19. Biostatistics and Epidemiology Lab	2.0
		20. Presentation & Viva-voce (total 8 courses)	8.0
		Total	105.0 Credits
Optional /Elective Courses	Theory	Comprehensive	4.0
	Lab	-	-
		Total	4.0 Credits
Capstone Courses	Lab	1. Field Work	1.0
		2. Research Project	3.0
		Total	4.0 Credits
Total		64 courses	145 (+4) credits

18. Year/Semester wise distribution of courses

First Year First Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
<u>STA 0542</u> <u>1151</u>	Principles of Statistics	Core	3	0	3.0
<u>STA 0542</u> <u>1152</u>	Principles of Statistics Lab	Core	0	4	2.0
<u>MAT</u> <u>0541 1103</u>	Basic Algebra	General Education	3	0	3.0
<u>ENG 0231</u> <u>1105</u>	English Language	General Education	2	0	2.0
<u>SSS 0222</u> <u>1107</u>	History of the Emergence of Independent Bangladesh	General Education	3	0	3.0

<u>STA 0542</u> <u>1150</u>	Presentation & Viva voce	Core	0	0	1.0
Total			11	4	14.0

First Year Second Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
<u>STA 0542</u> <u>1251</u>	Introduction to Probability	Core	3	0	3.0
<u>STA 0542</u> <u>1253</u>	Sampling Techniques – I	Core	3	0	3.0
<u>STA 0542</u> <u>1254</u>	Sampling Techniques – I Lab	Core	0	4	2.0
<u>STA 0542</u> <u>1256</u>	Introduction to Computer and SPSS (Lab)	Core	0	3	1.5
<u>MAT</u> <u>0541 1205</u>	Calculus	General Education	3	0	3.0
<u>MAT</u> <u>0541 1207</u>	Linear Algebra	General Education	3	0	3.0
<u>ENG 0231</u> <u>1209</u>	Academic Writing	General Education	2	0	2.0
<u>STA 0542</u> <u>1250</u>	Presentation & Viva voce	Core	0	0	1.0
Total			14	7	18.5

Second Year First Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
<u>STA 0542</u> <u>2151</u>	Probability Distributions	Core	3	0	3.0
<u>STA 0542</u> <u>2153</u>	Theory of Statistics	Core	3	0	3.0
<u>STA 0542</u> <u>2154</u>	Theory of Statistics Lab	Core	0	4	2.0

<u>STA 0542</u> <u>2156</u>	Statistical Computing with C++ & STATA (Lab)	Core	0	3	1.5
<u>MAT</u> <u>0541 2105</u>	Advanced Calculus & Differential Equations	General Education	3	0	3.0
<u>ECO 0311</u> <u>2107</u>	Principles of Microeconomics	General Education	3	0	3.0
<u>STA 0542</u> <u>2150</u>	Presentation & Viva voce	Core	0	0	1.0
Total			12	7	16.5

Second Year Second Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
<u>STA 0542</u> <u>2251</u>	Regression Analysis – I	Core	3	0	3.0
<u>STA 0542</u> <u>2252</u>	Regression Analysis – I Lab	Core	0	3	1.5
<u>MAT</u> <u>0541 2203</u>	Numerical Methods	General Education	3	0	3.0
<u>MAT</u> <u>0541 2205</u>	Real Analysis	General Education	3	0	3.0
<u>ECO</u> <u>0311 2207</u>	Principles of Macroeconomics	General Education	3	0	3.0
<u>CSE 0612</u> <u>2209</u>	Database Management & Programming	General Education	2	0	2.0
<u>CSE 0612</u> <u>2211</u>	Database Management & Programming Lab	General Education	0	6	3.0
<u>STA 0542</u> <u>2250</u>	Presentation & Viva voce	Core	0	0	1.0
Total			14	09	19.5

Third Year First Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
<u>STA 0542</u> <u>3151</u>	Design & Analysis of Experiments – I	Core	3	0	3.0
<u>STA 0542</u> <u>3152</u>	Design & Analysis of Experiments – I Lab	Core	0	4	2.0
<u>STA 0542</u> <u>3153</u>	Statistical Inference	Core	3	0	3.0
<u>STA 0542</u> <u>3154</u>	Statistical Inference Lab	Core	0	4	2.0
<u>STA 0542</u> <u>3155</u>	Statistical Simulation and Data Analysis with R & Python	Core	2	0	2.0
<u>STA 0542</u> <u>3156</u>	Statistical Simulation and Data Analysis with R & Python Lab	Core	0	3	1.5
<u>STA 0542</u> <u>3157</u>	Linear Programming	Core	3	0	3.0
<u>STA 0542</u> <u>3150</u>	Presentation & Viva-voce	Core	0	0	1.0
Total			11	11	17.5

Third Year Second Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
<u>STA 0542</u> <u>3251</u>	Stochastic Processes	Core	3	0	3.0
<u>STA 0542</u> <u>3252</u>	Stochastic Processes Lab	Core	0	4	2.0
<u>STA 0314</u> <u>3253</u>	Demography	Core	3	0	3.0
<u>STA 0314</u> <u>3254</u>	Demography Lab	Core	0	4	2.0
<u>STA 0542</u> <u>3256</u>	Data Analysis with SAS (Lab)	Core	0	3	1.5

<u>STA 0542</u> <u>3257</u>	Regression Analysis – II	Core	3	0	3.0
<u>STA 0542</u> <u>3258</u>	Regression Analysis – II Lab	Core	0	4	2.0
<u>STA 0542</u> <u>3259</u>	Field Work	Core	7 Days		1.0
<u>STA 0542</u> <u>3250</u>	Presentation & Viva-voce	Core	0	0	1.0
Total			11	16	18.5

Fourth Year First Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
<u>STA 0542</u> <u>4151</u>	Economic Statistics	Core	3	0	3.0
<u>STA 0542</u> <u>4152</u>	Economic Statistics Lab	Core	0	4	2.0
<u>STA 0542</u> <u>4153</u>	Applied Statistics	Core	3	0	3.0
<u>STA 0542</u> <u>4154</u>	Applied Statistics Lab	Core	0	3	1.5
<u>STA 0542</u> <u>4155</u>	Design & Analysis of Experiments – II	Core	3	0	3.0
<u>STA 0542</u> <u>4156</u>	Design & Analysis of Experiments – II Lab	Core	0	4	2.0
<u>STA 0542</u> <u>4157</u>	Sampling Techniques – II	Core	3	0	3.0
<u>STA 0542</u> <u>4158</u>	Sampling Techniques – II Lab	Core	0	4	2.0
<u>STA 0542</u> <u>4150</u>	Presentation & Viva-voce	Core	0	0	1.0
Total			12	15	20.5

Fourth Year Second Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
<u>STA 0542</u> <u>4251</u>	Multivariate Analysis	Core	3	0	3.0
<u>STA 0542</u> <u>4252</u>	Multivariate Analysis Lab	Core	0	4	2.0
<u>STA 0542</u> <u>4253</u>	Biostatistics and Epidemiology	Core	3	0	3.0
<u>STA 0542</u> <u>4254</u>	Biostatistics and Epidemiology Lab	Core	0	4	2.0
<u>STA 0542</u> <u>4255</u>	Generalized Linear Models	Core	2	0	2.0
<u>STA 0542</u> <u>4257</u>	Research Methodology	Core	2	0	2.0
<u>STA</u> <u>0542-4261</u>	Introduction to Data Science	Core	2		2.0
<u>STA 0542</u> <u>4258</u>	Research Project	Core	30 Days		3.0
<u>STA 0542</u> <u>4259</u>	Comprehensive	Optional	4	0	4.0
<u>STA 0542</u> <u>4250</u>	Presentation & Viva-voce	Core	0	0	1.0
Total			12 (+4)	08	20 (+4)

Part C

Detailed Course Curriculum 2022-2023

First Year First Semester Course Details

Course Code: <u>STA 0542 1151</u>	Credit: 3.0	Year: 1 st	Semester: 1 st
Course Title: Principles of Statistics		Course Status: Theory	

Rationale of the Course: This course is a fundamental one which will develop the foundation skills that prepare students to pursue more advanced topics in statistics. Therefore, this course is designed to acquire knowledge on introductory statistical concepts.

Course Objectives: The objectives of the course are

- To provide a good understanding of statistical principles and descriptive methods,
- To make students understand the graphical presentation of data,
- To help students conceptualize introductory concepts of bivariate data analysis,
- To acquaint students with various ways of measuring statistical data.

Course Contents

Introduction: Meaning of statistics, Descriptive and inferential statistics, Elements of statistics-Population, Parameter, Sample, Statistic, Estimator, Estimate, Variable, Attribute, Measurements Scales, Data.

Summarisation and presentation of data: Classification and tabulation of data, Formation of frequency distribution, Charting data-bar diagram, pie diagram, scatter diagram, line graph, graphs of frequency distribution-histogram, frequency polygon, frequency curve, cumulative frequency polygon, cumulative frequency curve or ogive.

Measures of central tendency or averages: Concept of central tendency, Objectives of averaging, Characteristics of a good average, Averages-arithmetic mean, geometric mean, harmonic mean, median, mode with their uses, merits and limitations; Properties of arithmetic mean and geometric mean, Relationship among the averages, Weighted arithmetic mean and geometric mean, Quantiles-quartiles, deciles and

percentiles; Uses of quantiles, Determination of mode, median and quantiles graphically.

Measures of dispersion: Meaning, Importance of studying dispersion, Characteristics of an ideal measure of dispersion, Measures of dispersion-range, quartile deviation, mean deviation, standard deviation, coefficient of dispersion, coefficient of variation, Uses, merits and demerits of range, quartile deviation, mean deviation, standard deviation; Properties of standard deviation, Relations among various measures of dispersion, Theorems related to dispersion, Graphic method of dispersion.

Shape characteristics of distribution: Introduction, moments, relation between moments, Effect of change of origin and scale on moments, Sheppard's correction for moments, Coefficients based on moments, Importance of moments, Study of skewness and kurtosis with various measures.

Association of attributes: Basic ideas, Purpose of studying association of attributes, Types of association, Methods of studying association.

Correlation and regression: Definition and types, Significance of the study of correlation and regression, Simple correlation and regression. Assumptions for regression analysis, Fitting of simple regression line- principles of least squares method, Methods of studying correlation, Properties of correlation and regression coefficients, Difference between correlation and regression analysis.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain statistics along with the fundamental concept of population, sample, parameter, estimator, statistic, variables, attributes, data, classification, tabulation, frequency distribution, chart, central tendency, dispersion, moments, skewness, kurtosis, correlation and regression;
CO2	Describe the different measures of central tendency, dispersion, skewness and kurtosis, simple correlation and regression, along with their merits and demerits;
CO3	Apply charts, classification, statistical table, various frequency distributions to summarise and present the data;
CO4	Determine the properties of the measures and relationships among measures, using the mathematical/algebraic operations;
CO5	Analyse the different forms of association of attributes and their measures.

Mapping Course Learning Outcomes (COs) with the POs

Course Learning Outcomes (CO)	3: Strong		2: Moderate		1: Weak	
	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill	PO 5	PO 6
CO1	2	2				
CO2	2					
CO3	1					
CO4	1					
CO5	3		1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Mid-semester examination 1 Semester-end examination
CO2	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Mid-semester examination 2 Semester-end examination
CO3	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Semester-end examination
CO4	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Semester-end examination
CO5	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Semester-end examination

Main Texts

- Ross S. M., (2010), Introductory Statistics, 3rd Edition, Academic Press, USA

Reference Books

1. Weiss N. A., (2016), Introductory Statistics, 10th Edition, Pearson
2. Rahman M. S., (2020), Statistics and Probability: An Introductory Analysis, Kazi Prokashoni, Dhaka
3. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Revised Edition, Sultan Chand and Sons, New Delhi, India
4. Islam M. N., (2006), Introduction to Statistics and Probability, 3rd Edition, Book World, Dhaka
5. Mostafa, M. G., (1989), Methods of Statistics, Karim Press and Publication, Dhaka, Bangladesh

Course Code: STA 0542 1152	Credit: 2.0	Year: 1 st	Semester: 1 st
Course Title: Principles of Statistics Lab		Course Status: Theory	

Rationale of the Course: This course aims to use learned skills for investigating statistical data. In particular, students will be able to conduct exploratory data analysis for a variety of scenarios.

- Course Objectives:** The objectives of the course are
- To provide skills on exploratory data analysis,
 - To make students capable of performing bivariate data analysis.

Course Contents
 Condensation and tabulation of data, frequency distribution, graphical representation of data, measures of central tendency, dispersion, skewness and kurtosis, measures of association, correlation and regression.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Summarise the data using classification, tabulation and frequency distribution;
CO2	Calculate various measures associated with central tendency, dispersion, moments, skewness, kurtosis, association of attributes, simple correlation and regression;
CO3	Present the data applying various diagrams and graphs;

CO4	Interpret the data.
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Mapping Course Learning Outcomes (COs) with the POs

	3: Strong	2: Moderate	1: Weak			
Course Learning Outcomes (CO)	Fundamental Skill PO 1	Social Skill PO 2	Thinking Skill PO 3	Personal Skill PO 4	PO 5	PO 6
CO1	2	2				
CO2	2	2				
CO3	2	1				
CO4	2	2				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors/assignment	Assignment/evaluation/class test (individual/group) Semester-end examination
CO 2	Lecture using board/projectors/assignment	
CO 3	Lecture using board/projectors/assignment	
CO 4	Lecture using board/projectors/assignment	

Main Texts

- Ross S. M., (2010), Introductory Statistics, 3rd Edition, Academic Press, USA

Reference Books

1. Weiss N. A., (2016), Introductory Statistics, 10th Edition, Pearson
2. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Revised Edition, Sultan Chand and Sons, New Delhi, India

- Rahman M. S., (2020), Statistics and Probability: An Introductory Analysis, Kazi Prokashoni, Dhaka
- Islam M. N., (2006), Introduction to Statistics and Probability, 3rd Edition, Book World, Dhaka
- Mostafa, M. G., (1989), Methods of Statistics, Karim Press and Publication, Dhaka, Bangladesh

Course Code: <u>MAT 0541 1103</u>	Credit: 3.0	Year: 1 st	Semester: 1 st
Course Title: Basic Algebra		Course Status: General Education	

Rationale of the Course: Acquiring knowledge regarding higher Algebra, that are frequently used in higher level of statistics education.

Course Objectives: The objectives of the course are

- Make students understand the set theory,
- Provide knowledge on complex numbers,
- Acquaint students with basic tools of different trigonometric series,
- Helping students to conceptualize the basic theories of inequalities,
- Facilitate necessary knowledge on linear equations of different orders.

Course Contents

Sets: Ideas of set, subset, superset, power set and product set; basic set operations, real number system. **Complex numbers:** Complex numbers and their properties, De Moivre’s theorem and its application, nth roots. **Summation of trigonometric series:** Method of difference, C+iS method. **Inequalities:** Properties and solutions of inequalities with their geometrical representations; Inequalities involving mean; Inequalities of Weierstrass, Cauchy, Tchebyshev and Jensen. **Theory of equations:** Polynomial and division algorithm; Fundamental theorem of algebra; Relations between roots and coefficients; Multiple roots; Transformations of equations; Increasing or decreasing of all roots; Removal of any term of an equation; Synthetic division; Nature of the roots; Descarte’s rule of signs.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Apply set theory in solving probability problems;
CO2	Employ complex numbers in solving statistical problems;
CO3	Outline the necessity and usefulness of different algebraic expressions, equations and models;
CO4	Employ inequalities in developing statistical theories;
CO5	Demonstrate how trigonometric series can be useful in statistics.

Mapping Course Learning Outcomes (COs) with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2			2		
CO2	2			2		
CO3	2			2		
CO4	2			2		
CO5	2			2		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Blackboard solution	Semester-end examination
CO 2	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 1; Semester-end examination
CO 3	Lecture using board/ projectors	Semester-end examination
CO 4	Lecture using board/	Midterm Examination 2; Semester-

	projectors	end examination
CO 5	Lecture using board/ Tutorial	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination

Main Text

- Hall & Knight, (2019), Higher Algebra, Arihant Publications India Limited

Reference Books

- Abramson, J. P., et al, (2015), Algebra and Trigonometry, OpenStax College, Rice University, ISBN 1938168372, 9781938168376
- Bernard & Child, (2019), Higher Algebra, Arihant Publications India Limited
- Rahman M. A., (1994), College Higher Algebra with Trigonometry and Set Theory, Nahar Book Depot & Publications
- Shahidullah A. N. M. & Bhattacharjee P. K., (1992), A Textbook on Higher Algebra and Trigonometry, 9th Edition, Chattogram
- Lipschutz S., (1998), Set Theory and Related Topics, 2nd Edition, Schaums Outline Series, McGraw-Hill Education
- Spiegel M. R., (2009), Vector Analysis, 2nd Edition, Schaums Outline Series, McGraw-Hill Education

Course Code: <u>ENG 0231 1105</u>	Credit: 2.0	Year: 1 st	Semester: 1 st
Course Title: English Language		Course Status: General Education	

Rationale of the Course: This course is expected to develop two basic skills i.e. reading and writing. A variety of reading strategies and texts will be used to effectively develop first year students' academic reading skills thereby facilitating their future study. Also, the course focuses on developing the writing skills of students by familiarizing them with grammar rules, providing them with practice and enabling them to demonstrate the accurate use of grammar in their writing.

Course Objectives: The objectives of the course are

- To enable students to write with accuracy,
- To facilitate effective and comprehensible writing,

- To raise awareness of common errors that occur in writing,
- To develop students' ability to understand write-ups on issues of general concern,
- To improve the vocabulary of learners for effective communication.

Course Contents

a) Reading

- Different Reading Strategies
- Guessing Meaning from the Context
- Critical Reading (Analyze)
- Critical Reading (Synthesize)
- Critical Reading (Evaluate)
- Annotation
- Summary Writing

b) Writing

- Forms and functions of different word categories (noun, verb, adjective, etc.)
- Aspects and uses of tense
- Subject-verb agreement
- Use of infinitive, gerund, present participle, past participle, modals, causatives, conditionals, subjunctives, modals.
- Use of sentence connectors/ cohesion markers/ punctuation
- Effective combination of sentences (simple, complex, compound)
- Developing a paragraph

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO 1	Apply grammar rules;
CO 2	Express oneself correctly by using appropriate words, phrases, sentences or ideas ;
CO 3	Critically reflect on a text (grasp abstract ideas and interpret them effectively, arrive at well-reasoned conclusions and solutions);
CO 4	Create using earned knowledge both independently and in collaboration with peer groups;
CO 5	Demonstrate a comprehension of subject knowledge and its

	subsequent use.
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Mapping Course Learning Outcomes (COs) with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		1	1		1	
CO2		1	1		1	
CO3		1	1		1	
CO4		1	1		1	
CO5		1	1		1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 2	Lecture using board/ Tutorial	Quiz/ Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ projectors	Semester-end examination
CO 4	Lecture using board/ projectors	Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination

Reference Books

- American edition American English grammar by example nodrm, *A New English Grammar*, 2021, ISBN 10:8650107737

- F. Stafford, N. Stephens , *Learn and Practise English Grammar 1* , Thomson, 2005.
- Gerald C. Nelson, Sidney Greenbaum, *An Introduction to English Grammar*, Edition: 4, Routledge, 2016.
- Liz and John Soars. *New Headway Upper Intermediate Student’s Book*. Oxford University Press, 2014.
- Martin J. Endley, *Linguistic Perspectives on English Grammar*, Information Age Publishing, 2010.
- Payle, Michael. *Cliff’s TOEFL Preparation Guide*. 12th ed., Cliffs Notes Inc., 2019.
- Tibbits, E. E.,editor. *Exercises in Reading Comprehension*. Longman, 2013.

Supplementary Materials

- A selection of 08-10 editorials and reports from newspapers/magazines/journals,etc.
- Reading texts in New Headway Upper Intermediate Student’s Book (Current edition)
- Selected passages from recommended books
- A selection of other materials may be supplied as handouts by the instructor as necessary

Course Code: SSS 0222 1107	Credit: 3.0	Year: 1 st	Semester: 1 st
Course Title: History of the Emergence of Independent Bangladesh		Course Status: General Education	

Rationale of the Course: This is a special compulsory course for all students of Bachelor program of Shahjalal University of Science and Technology, Sylhet. This course deals with the interrelated themes and topics that are essential to understand the emergence of Bangladesh.

Course Objectives: The objectives of the course are
The objectives of this course in general are to make students understand the causes of Liberation War, growth and development of Bengali nationalism and identity, national emancipation of the Bangalis. The specific course objectives are:

- To give an idea about the War of Liberation and freedom fighters,
- To clarify the role of different sections of people in the War of Liberation,

- 3) To explain the role of Bangabandhu in Liberation War,
- 4) To give an idea about the sacrifices of martyrs for the motherland.

Course Contents

1. Description of the land and its people

- b. Impacts of geographical features
- c. Ethnic composition of Bengal
- d. Development of Bengali language and its significance
- e. Cultural syncretism and religious tolerance
- f. Distinctive identity of Bangalis in the context of undivided Bengal

2. Proposal for United Independent Bengal State, Pakistan movement and foreshadowing of Bangladesh, the 1947 partition of the subcontinent

- a. Rise of communalism under the British colonial rule
- b. The 1940 Lahore Resolution
- c. Suhrawardy's move for undivided independent Bengal
- d. The establishment of Pakistan, 1947
- e. Foundation of the Awami Muslim League (1949) and the struggle for emancipation of the Bangalis

3. Pakistan: Structure of the state and disparity

- a. Central and provincial structures
- b. Influence of military and civil bureaucracies
- c. socio-economic, political and cultural disparities

4. Language movement and quest for Bengali identity

- a. Misrule by Muslim League and struggle for democratic politics
- b. The Language movement: context, phases and international recognition of 21 February as Mother Language Day
- c. United Front elections of 1954 : Results and consequences

5. Military rule: the regimes of Ayub Khan (1958-1969) and Yahia Khan (1969-1971)

- a. Military rule and its characteristics
- b. Ayub Khan's rise to power and characteristics of his rule (political repression, Basic democracy, Islamisation)

- c. Fall of Ayub regime and Pakistan under Yahya military junta

6. Rise of Bangali nationalism and the movement for the right to self-determination

- a. Resistance against Pakistani cultural aggression and resurgence of Bengali nationalism
- b. Bangabandhu Sheikh Mujibur Rahman's 6-points programme (1966) : Its significance and reaction of the regime
- c. The Agartala Conspiracy Case, 1968

7. Election of 1970 and its significance

- a. Legal Framework Order (LFO) of general Yahya Khan
- b. Programmes of different political parties
- c. Election results
- d. Pakistani military junta's conspiracy to thwart the results

8. Non-cooperation movement and 7th March address of Bangabandhu

- a. The non-cooperation movement against Pakistani rule and its salient features
- b. 7th March address of Bangabandhu : Background
- c. Significance of 7th March address
- d. International recognition of 7th March address as world heritage by UNESCO (2017)

UNESCO (2017)

9. Declaration of Independence of Bangladesh

- a. Operation Searchlight (25 March 1971)
- b. Declaration of Independence of Bangladesh by Bangabandhu
- c. Beginning of the Liberation War of Bangladesh

10. The War of Liberation, 1971

- a. Genocide, repression of women, Bangali refugees in India
- b. Formation of Bangladesh government and Constitutional proclamation of Independence
- c. The spontaneous early resistance and subsequent organized resistance by Mukti

- Fouz, Mukti Bahini, Guerrillas and the frontal war in December 1971
- Campaign in favour of the War of Liberation (Shadhin Bangla Betar Kendra, campaigns in abroad and formation of international public opinion)
 - Contribution of students, women, the mass people and different political parties in the War of Liberation
 - The role of great powers and the United Nations in the Liberation War
 - The contribution of India in the Liberation War
 - The anti-liberation activities of the Peace Committee, Al-Badar, Al-Shams, Rajakars, pro-Pakistani political parties and other Pakistani collaborators, killing of the Bangali intellectuals at the end of the war
 - Arrest and Trial of Bangabandhu in Pakistani custody and reaction of the World community
 - Formation of joint command of Mukti Bahini and Indian allied forces and Victory in the war
 - Evaluation of Bangabandhu's contributions in the Independence of Bangladesh

11. The Bangabandhu government, 1972-1975

- Homecoming of Bangabandhu and his address at Race Course on 10 January 1972
- Making of the Bangladesh Constitution, 1972
- Reconstruction of the war-ravaged country by Bangabandhu government
- Foreign policy of Bangabandhu; his first address at the United Nations in 1974
- Bangabandhu's 'Second Revolution' or System change, 1975
- The assassination of Bangabandhu and his family members and the ideological turn-around

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain fundamental characteristics of politics of East Pakistan from 1947 to 1971;
CO2	Gather knowledge on the post-colonial nationalist resistance during Pakistan period and the background of the establishment of Bangladesh;
CO3	Describe the disintegration of East-West Pakistan and emergence of new nation state, Bangladesh;
CO4	Outline the nature and dynamics of different political movements of Pakistan from 1947 to 1971 and evaluate the contributions of various actors;

CO5	Evaluate the role of Bangabandhu Sheikh Mujibur Rahman in the creation of independent Bangladesh.
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Mapping Course Learning Outcomes (COs) with the POs

	3: Strong	2: Moderate	1: Weak		
Course Learning Outcomes (CO)	Fundamental Skill PO 1	Social Skill PO 2	Thinking Skill PO 3	Personal Skill PO 4	PO 5 PO 6
CO1			1		1
CO2			1		1
CO3			1		1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Semester-end examination
CO 2	Lecture using board/projectors	Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/projectors	Quiz/ Semester-end examination
CO 4	Lecture using board/projectors	Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Reference Books

- Ahmed, Salahuddin and Bazlul Mobin Chowdhury (eds.), *Bangladesh: National Culture and Heritage: An Introductory Reader* (Dhaka: Independent University Bangladesh, 2004)

- Harun-or-Roshid, *The Foreshadowing of Bangladesh: Bengal Muslim League and Muslim Politics, 1906-1947* (Dhaka : The University Press Limited, 2012)
- Harun-or-Rashid, *The Foreshadowing of Bangladesh: Bengal Muslim League and Muslim politics, 1906-1947.* (Dhaka: The University Press Limited 2003)
- Harun-or-Rashid, *From 1947 Partition to Bangladesh: BANGABANDHU and State Formation in Perspective.* (Dhaka: The University Press Limited 2021)
- Jahan Rounaq, *Pakistan: Failure in National Integration*,(Dhaka : The University Press Limited, 1977)
- Jahan Rounaq, *Political Parties in Bangladesh*, (Dhaka: Prothoma Prokashan 2015)
- Talukder Maniruzzaman, *Radical Politics and the Emergence of Bangladesh*, (Dhaka : Mowla,Brothers, 2003)
- Talukdar Maniruzzaman , *The Bangladesh Revolution and Its Aftermath*, (Dhaka: UPL 2003)
- Nurul Islam, *Making of a Nation : Bangladesh- An Economist Tale*, (Dhaka: UPL 2013)
- হারুন-অর-রশিদ, *বাংলাদেশ : রাজনীতি সরকার ও শাসনতান্ত্রিক উন্নয়ন ১৭৫৭-২০১৮*, (ঢাকা: অন্যপ্রকাশ ২০১৮)
- হারুন-অর-রশিদ, *বঙ্গীয় মুসলিম লীগ : পাকিস্তান আন্দোলন, বাঙালির রাষ্ট্রভাবনা ও বঙ্গবন্ধু*, (ঢাকা: অন্যপ্রকাশ ২০১৮)
- হারুন-অর-রশিদ, *এই মার্চের ভাষণ কেন বিশ্ব-ঐতিহ্য সম্পদ, বঙ্গবন্ধু মুক্তিযুদ্ধ বাংলাদেশ*, (ঢাকা: অন্যপ্রকাশ ২০১৮)
- শেখ মুজিবুর রহমান, *অসমাপ্ত আত্মজীবনী*, (ঢাকা: ইউপিএল ২০১২)
- শেখ মুজিবুর রহমান, *কারাগারের রোজনামা*, (বাংলা একাডেমি ২০১৭)
- অলি আহাদ, *জাতীয় রাজনীতি, ১৯৪৫-১৯৭৫*, (ঢাকা: বাংলাদেশ কো-অপারেটিভ বুকস সোসাইটি ২০০৪)
- সৈয়দ আনোয়ার হোসেন : *বাংলাদেশের স্বাধীনতায়ুদ্ধে পরাশক্তির ভূমিকা*, (ঢাকা : ডানা প্রকাশনী, ১৯৮২)
- আবুল মাল আবদুল মুহিত : *বাংলাদেশ: জাতিরাষ্ট্রের উদ্ভব*, (ঢাকা : সাহিত্য প্রকাশ, ২০০০)

Course Code: STA 0542 1150	Credit: 1.0	Year: 1 st	Semester: 1 st
Course Title: Presentation & Viva-voce		Course Status: Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through

presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

- Course Objectives:** The objectives of the course are
- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
 - Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

- Reference Books**
- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2					
CO2	2				1	
CO3	2				1	1

CO4	1					1
CO5	1				1	1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

First Year Second Semester Course Details

Course Code: STA 0542 1251	Credit: 3.0	Year: 1 st	Semester: 2 nd
Course Title: Introduction to Probability		Course Status: Theory	

Rational of the Course: The basic concepts of probability are essential in almost all areas of statistics. Most of the statistical methods, in some way, are related to probability theory. Therefore, acquiring knowledge on basic probability and probability distribution is necessary for the graduates of statistics.

Course Objectives: The objectives of the course are

- Make students understand the fundamental concepts of probability,
- Helping students to develop ability in applications and methods of basic probability.

Course Contents

Probability: Sets and their properties, experiment, random experiment, sample space, events, union and intersection of events, different types of events, probability of

events, classical approach of probability, empirical approach of probability, axiomatic development of probability, conditional probability, independence of events, additive and multiplicative laws of probability. Theorem of total probability and compound probability, Bayes' theorem, realization of m among n events. Solving probability problems. **Random variables:** definition, probability function, distribution function, joint, marginal and conditional probability functions. **Mathematical expectation:** expectation and variance of a random variable, properties of mathematical expectation and variance, conditional expectation and conditional variance, covariance and correlation, Chebyshev's and Markov inequalities. Moments, moment generating function, and characteristic function. Introduction to probability distributions.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Demonstrate basic concepts of probability and its axioms and discrete and continuous random variable;
CO2	Derive the marginal probability distributions and conditional probability distributions from joint probability distributions ;
CO3	Differentiate between prior and posterior probabilities by using Bayes theorem;
CO4	Calculate mean and variance from moment generating function as well as conditional expectation and conditional variance;
CO5	Familiar with common discrete and continuous distribution of random variables.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1		1		
CO2	2	1		1		
CO3	2	1		1		
CO4	2			1		

CO5	2	2		1		
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Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Semester-end examination
CO 2	Lecture using board/Tutorial	Quiz Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/Tutorial	Quiz Semester-end examination
CO 4	Lecture using board/Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Ross S. M., (2018), A First Course in Probability, 9th Edition, Academic Press, NY
2. Khan M. S. H., (2022), Elements of Probability Theory & its Applications, The University Press Limited, Dhaka.

Reference Books

1. Islam M N, (2006), Introduction to Statistics and Probability, 3rd Edition, Book World, Dhaka
2. Roy M. K., (2011), Fundamentals of Probability and Probability Distributions, 8th Edition, ROMAX Publications, Chittagong
3. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand and Sons, New Delhi, India
4. Hoq A. K. M. S., (1996), Probability: An Introduction, 1st Edition, Dhaka

5. Meyer A., Probability and Statistics, Addison-Wesley, USA
6. Mostafa M. G., (1989), Methods of Statistics, Karim press and publication, Dhaka Bangladesh
7. Mosteller et al, Probability with Statistical Applications, 2nd Edition, Addison-Wesley, USA
8. Parzen E, Modern Probability Theory and Its Applications, John Wiley, NY
9. Rahman M. S., (2020), Statistics and Probability: An Introductory Analysis, Kazi Prokashoni, Dhaka

Course Code: STA 0542 1253	Credit: 3.0	Year: 1 st	Semester: 2 nd
Course Title: Sampling Techniques – I		Course Status: Theory	

Rationale of the Course: Sample survey is an essential tools for collecting primary data. To conduct a sample survey, students need to know proper sampling techniques. Therefore, this course is designed to acquire knowledge on several sampling techniques.

Course Objectives: The objectives of the course are

- Familiarize students with the concepts of sampling, sampling techniques, census, survey design and methods of data collection,
- Conceptualize different sampling techniques such as simple random sampling, stratified random sampling, systematic sampling, cluster sampling,
- Facilitate necessary knowledge to compare the efficiency among different sampling techniques,
- Provide knowledge to select appropriate sampling technique for collecting data according to the requirement of problems to be analyzed.

Course Contents

Introduction: Concept and scope of sampling, sampling versus census, steps of survey, questionnaire, pilot survey, probability and non-probability sampling, sampling and non-sampling errors, bias and precision, determination of sample size.

Random sampling design: simple random sampling, stratified random sampling, systematic sampling, and cluster sampling. Estimation of population total, mean,

proportion and their standard errors. Ratio and regression methods of estimation. Merits, demerits and applications of different sampling techniques.

Non-probability sampling: Convenience sampling, Purposive/judgment sampling, quota sampling, snowball sampling: merits, demerits and applications.

Course Learning Outcomes (COs): By the end of the course, students will be expected to–

CO1	Prepare the layouts of different sampling techniques;
CO2	Apply methods and analytical tools for collecting data;
CO3	Compare efficiency of alternative sampling designs;
CO4	Estimates of parameters along with confidence intervals of the parameters;
CO5	Collaborate in a project for collecting primary data.

Mapping Course Learning Outcomes (COs) with the POs

Course Learning Outcomes (CO)	3: Strong		2: Moderate		1: Weak	
	Fundamental Skill		Social Skill		Thinking Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3				
CO2	2	3				
CO3		3				
CO4						
CO5	2	3				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	assignment/presentation (individual/group), semester end examination

CO 3	Lecture using board/ assignment	assignment/presentation (individual/group), semester end examination
CO 4	Lecture using board/ assignment	assignment/presentation (individual/group), semester end examination
CO 5	Lecture using board/ Group works	presentation (individual/group), semester end examination

Main Texts

1. Cochran W. G., (1977), Sampling Techniques, 3rd Edition, John Wiley, NY
2. Lohr S. L., (2010), Sampling: Design and Analysis, 2nd Edition, MPS Limited, Macmillan, USA

Reference Books

1. Raj D., (1968), Sampling Theory, Tata McGraw-Hill, Delhi
2. Islam M. N., (2005), An Introduction to Sampling Methods, 1st Edition, Book World, Dhaka.
3. Kish L., (1968), Survey Sampling, Wiley, 1st Edition, NY
4. Sukhatme P. V., (1984), Sampling Theories and Surveys with Applications, 3rd Edition, Iowa State University Press, USA

Course Code: STA 0542 1254	Credit: 2.0	Year: 1 st	Semester: 2 nd
Course Title: Sampling Techniques – I Lab		Course Status: Theory	

Rationale of the Course: This course gives methodological knowledge on the different techniques to draw a sample from the population. This Lab course is designed to apply the several sampling techniques on different situations of the data for conducting a sample survey.

Course Objectives: The objectives of the course are

- Help students develop ability to draw sample using different sampling techniques such as simple random sampling, stratified random sampling, systematic sampling, cluster sampling;
- Make students capable to measure the efficiencies of different sampling techniques and compare them.

Course Contents

Random sampling and sampling techniques: drawing sample from the population with replacement and without replacement using random number. Construct sampling distribution, Estimate unbiased estimators of population mean/total, proportion, and their standard errors as well as confidence intervals using different sampling techniques: simple random sampling, stratified random sampling, systematic sampling, and cluster sampling. Compare different sampling techniques. Determine sample size.

Ratio and regression method of estimation: estimate the ratio estimators and difference estimators of mean and total with standard errors.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Determine appropriate methods and analytical tools for collecting data;
CO2	Draw sample from population through different sampling techniques;
CO3	Collect primary data from different sources;
CO4	Produce necessary estimates of parameters along with confidence intervals of the parameters;
CO5	Compare efficiency of alternative sampling designs.

Mapping Course Learning Outcomes (COs) with the POs

Course Learning Outcomes (CO)	3: Strong		2: Moderate		1: Weak	
	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3				
CO2	2	3				

CO3		3				
CO4						
CO5	2	3				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors	
CO 3	Lecture using board/ projectors	
CO 4	Lecture using board/ Tutorial	
CO 5	Lecture using board/ Assignment	

Main Texts

1. Cochran W. G., (1977), Sampling Techniques, 3rd Edition, John Wiley, NY
2. Lohr S. L., (2010), Sampling: Design and Analysis, 2nd Edition, MPS Limited, Macmillan, USA

Reference Books

1. Raj D., (1968), Sampling Theory, Tata McGraw-Hill, Delhi
2. Islam M. N., (2005), An Introduction to Sampling Methods, 1st Edition, Book World, Dhaka.
3. Kish L., (1968), Survey Sampling, Wiley, 1st Edition, NY
4. Sukhatme P. V., (1984), Sampling Theories and Surveys with Applications, 3rd Edition, Iowa State University Press, USA

Course Code: STA 0542 1256	Credit: 1.5	Year: 1 st	Semester: 2 nd
Course Title: Introduction to Computer and SPSS Lab			Course Status: Lab

Rationale of the Course: Acquiring knowledge on basic computer and statistical applications with SPSS.

Course Objectives: The objectives of the course are

- Acquaint students with the fundamental computing tools in quantitative analytical methods,
- Provide knowledge of data analysis with SPSS,
- Facilitate necessary knowledge about data wrangling and exploratory data analysis,
- Develop skills to apply probability distributions, regression and linear models.

Course Contents

Introduction to Computers and MS Office: Practically learn basic idea on computers including internet; learn MS word, perform standard statistical analysis using Excel including graphical representation of data and learn power point presentation. **Statistical Analysis using SPSS:** Data entry, data cleaning and data management, graphical representation of data, calculation of different measures of central tendency, dispersion, skewness, kurtosis, association of attributes, correlation and regression.

Course learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Explain basic tools of computer including system and application based software;
CO2	Prepare data including data entry, organizing, cleaning and saving data in a suitable way, for instance,Excel and SPSS;
CO3	Modify a dataset for required analysis using SPSS;
CO4	Create graphical presentation of data using Excel and SPSS;
CO5	Solve descriptive and inferential statistical problems using Excel and SPSS.

Mapping Course Learning Outcomes (COs)with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill		Thinking Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3		3	3	1
CO2		3		1	2	1
CO3		3			2	1

CO4		3		1	2	1
CO5		3		2	3	2

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/computer/tutorial using statistical software	Quiz/ Assignment/Lab Reports (individual/group) Class assessment, Semester-end Examination including Viva-voce
CO 2		
CO 3		
CO 4		
CO 5		

Main Texts

1. Field, A., (2018), Discovering Statistics Using IBM SPSS Statistics: North American Edition 5th Edition
2. George D., & Mallery P., (2016), IBM SPSS Statistics 23 Step by Step: A Simple Guide and Reference, 14th Edition, Routledge
3. Lambert J., (2018), Microsoft PowerPoint 2019 Step by Step, 1st Edition, Microsoft Press, USA
4. Lambert J., (2018), Microsoft Word 2019 Step by Step, 1st Edition, Microsoft Press, USA

Course Code: <u>MAT 0541 1205</u>	Credit: 3.0	Year: 1 st	Semester: 2 nd
Course Title: Calculus			Course Status: General Education

Rationale of the Course: Acquiring solid foundations for applications of calculus in statistical theory.

Course Objectives: The objectives of the course are

- To make students understand the basic concepts of differential and integral calculus,
- To help students for solving statistical problems using necessary calculus.

Course Contents

Differential Calculus: Functions of the real variable and their graphs; limit, continuity and derivative; physical meaning of derivative of a function; higher derivatives; Leibnitz's theorem; Rolle's theorem; mean value theorem; Taylor's theorem; Taylor's and Maclaurin's series without proofs; maximum and minimum values of a function; functions of two and three variables; partial and total derivatives; concavity and convexity of a function. **Integral Calculus:** Physical meaning of integration of a function; evaluation of indefinite integrals; definition of Riemann integral; fundamental theorem of integral calculus and its application to definite integrals; double and triple integration; application of integration in finding lengths, areas and volumes.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Define the basic concepts and principles of differential and integral calculus of real functions and sequences and series;
CO2	Interpret the geometric meaning of differential and integral calculus;
CO3	Apply the concept and principles of differential and integral calculus to solve geometric and physical problems
CO4	Analyze the properties of functions using graphs;
CO5	Solve complex problems by combining the acquired mathematical concepts and principles.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2					
CO2	2			2		
CO3	2					
CO4	2					
CO5	2			2		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Semester-end examination
CO 2	Lecture using board/projectors	Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/Tutorial	Quiz/ Semester-end examination

Main Text:

Anton, H. (1995). Calculus with Analytic Geometry, 5th Edition, John Wiley and Sons, NY, USA.

Reference Books

1. Das & Mukherjee, Differential Calculus, 52nd Edition, U. N. Dhur & Sons Limited, Kolkata
2. Das & Mukherjee, Integral Calculus, U. N. Dhur & Sons Limited, Kolkata
3. Swokowski E. W., Calculus with Analytic Geometry, 2nd Edition, Wadsworth Inc, USA
4. Thomas & Finney, Calculus and Analytic Geometry, 9th Edition, Pearson Education Inc and Dorling Kinderslay Publishing Inc, New Delhi
5. Tierney, Calculus with Analytic Geometry, 3rd Edition, Allyn & Bacon Inc, USA

Course Code: MAT 0541 1207	Credit: 3.0	Year: 1 st	Semester: 2 nd
Course Title: Linear Algebra		Course Status: General Education	

Rationale of the Course: Acquiring knowledge of linear algebra to solve problems on different statistical models.

Course Objectives: The objectives of the course are

- Acquaint students with basic concepts of matrices and matrix algebra,
- Facilitate necessary knowledge on methods of solving systems of linear equations,
- Make students understand the basic concepts of vector spaces,
- Provide knowledge on concepts of linear transformations,
- Help students to conceptualize operations in matrix and describe their properties,
- Facilitate understanding on methods of computing using eigenvalues and eigenvectors.

Course Contents

Matrix: Definition of a matrix, different types of matrices, addition and multiplication of matrices. Adjoint and inverse of matrix, Cramer's rule, application of inverse matrix and Cramer's rule. Elementary row operations and echelon forms of matrices, rank, row rank, column rank of a matrix and their equivalence, use of rank and echelon forms in solving system of homogeneous and nonhomogeneous equations. Quadratic forms & their properties. g-inverse. Vector space and subspace over reals and direct sum, linear combination, linear dependence and independence of vectors, basis and dimension of vector space, quotient space and isomorphism theorems, linear transformations, kernel, rank and nullity nonsingular transformations and matrix representation, changes of basis, eigenvector. Eigenvalues, characteristic equations and Cayley-Hamilton theorem. Similar matrices, canonical forms orthogonal and Hermitian matrices, inner product, orthogonal vectors and orthonormal bases, Gram-Schmidt orthogonalization process. Bilinear and quadratic forms. Kronecker sums and products of matrices.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Solve systems of linear equations;
CO2	Describe the concept of vector spaces;
CO3	Calculate determinants of matrices, eigenvalues and eigenvectors;
CO4	Describe linear transformations to find matrices;
CO5	Apply linear algebra to discrete calculus, graphs and networks.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2			2		
CO2	2					
CO3	2					
CO4	2			2		
CO5	2			2		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 2	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board	Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination

Main Text:

1. Hadely G., (1961), Linear Algebra, Addison-Wesley, NY
2. Searle S. R., Matrix Algebra Useful for Statistics, John Wiley, NY

Reference Books

1. Ayres F., Theory and Problems of Matrices, Schaum’s Outline Series, McGraw Hill, NY
2. Bering E. D., Linear Algebra and Matrix Theory
3. Hamilton A. G., Linear Algebra, 4th Edition, Cambridge University Press
4. Khanna M. I. & Pundir S. K., Linear Algebra, 11th Edition, Jai Prakash Nath & Co, India
5. Kolman B., Elementary Linear Algebra, 9th Edition, Pearson Education Inc, New Jersey
6. Lipschutz S. & Lipson M., Linear Algebra, 6th Edition, Schaum’s Outline Series, McGraw Hill, NY
7. Morris A. O., Linear Algebra, 2nd Edition, Chapman and Hall/CRC, USA
8. Narayan S., Mittal P. K., (2010), A Textbook of Matrices, Sultan Chand & Co., India.
9. Rahman M. A., College Linear Algebra, 7th Edition, Nahar Book Depot & Publications

Course Code: ENG 0231 1209	Credit: 2.0	Year: 1 st	Semester: 2 nd
Course Title: Academic Writing		Course Status: General Education	

Rationale of Course: This course is designed to teach students the basics of academic writing and enable them to write paragraphs, essays and letters using appropriate vocabulary and formats.

Course Objectives: The objectives of the course are

- To develop students’ understanding of the specifics of academic writing,
- To instruct students on how to writing academic papers, e.g. essays, assignments, reports, etc.,
- To facilitate proper writing of letters of complaint, job applications,
- To offer students the environment to strengthen their vocabulary.

Course Contents

- Features of Academic Writing Style: Complexity, formality, precision, objectivity, explicitness, accuracy, hedging, organization, planning, impersonal, cohesive, coherent, authenticity, etc.
- Formal and informal English
- Paragraph Development: Topic sentence, developers, modulators, terminators
- Essay Types:
 - Argumentative essays
 - Persuasive essays
 - Expository essays
- Essay Development:
 - Effective introduction
 - Body paragraphs
 - Conclusion
- Formal letters on social, official and business correspondence, fax, e-mail, letters of opinion, complaint
- Report writing (academic and nonacademic)
- Formatting:
 - In-text citation
 - Referencing

Course Learning Outcomes (COs): By the end of the course, students will be expected to -

CO 1	Organize ideas coherently in paragraphs and essays;
CO 2	Create varied correspondence correctly;
CO 3	Adhere to the rules of writing mechanics ;
CO4	Use appropriate vocabulary and phrases;
CO5	Self-correct and collaborate with peer groups.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6

CO1	1		1		2	2
CO2					2	2
CO3					2	2
CO4	1		1		2	2
CO5	1		1		2	2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 2	Lecture using board/ projectors	Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 5	Lecture using board/ Tutorial	Quiz/ Semester-end examination

Books and Resources

1. Alice Oshima and Ann Hogue. *Introduction to Academic Writing*, THIRD EDITION, Longman, 2007
2. Chalmers, Robert. *Academic English Course Book*. Chalmers, 2011.
3. Dorothy E Zemach and Lisa A Rumisek. *Academic Writing: from paragraph to essay*, Macmillan, 2003
4. George Orwell. "Politics and the English Language." Penguin Modern Classics, Paperback – International Edition, January 15, 2013
5. Hewings, Martin, and Craig Thaine. *Cambridge Academic English: An Integrated Skills course for EAP*. Cambridge University Press, 2012.

6. Imhoof, Maurice L., and Herman Hudson. *From Paragraph to Essay: Developing*
7. *Composition Writing*. Longman, 1975.
8. Stephen Bailey. *Academic Writing: A practical guide for students*, Routledge, 2003

Course Code: STA 0542 1250	Credit: 1.0	Year: 1 st	Semester: 2 nd
Course Title: Presentation & Viva-voce			Course Status: Lab

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;

CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2					
CO2	2				1	
CO3	2				1	1
CO4	1					1
CO5	1				1	1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Second Year First Semester Course Details

Course Code: STA 0542 2151	Credit: 3.0	Year: 2 nd	Semester: 1 st
Course Title: Probability Distributions		Course Status: Theory	

Rationale of the Course: This course is designed to provide a comprehensive understanding of probability theory and statistical distributions, essential for advanced studies in statistics and data analysis. Beginning with a review of fundamental concepts, the course will ensure a solid foundational understanding of probability distributions. Students will explore both common univariate discrete and continuous distributions in depth and will also be introduced to more complex distributions. The curriculum will cover special topics in truncated and censored distributions and will include an introduction to bivariate distributions. This course will equip students with the necessary tools to analyze and interpret a wide range of probabilistic models, fostering a robust analytical skill set applicable in real-world scenarios across various scientific, engineering, and social science disciplines.

Course Objectives: The objectives of the course are

- Explore basic and advanced ideas in probability and statistics to understand various types of random variables and their distributions.
- Study a variety of probability models, from simple to complex ones like truncated and censored distributions, to enhance critical thinking and analytical abilities.
- Learn how different probability distributions are connected, aiding in the comprehension of basic principles and the development of advanced analytical methods crucial for real-world data analysis and decision-making.
- Develop practical proficiency in applying different probability distributions to address challenges in diverse fields.

Course Contents

Review of Related Concepts: Probability function, Random variable, moment generating function, characteristic function, factorial moment generating function, cumulant generating function, probability generating function of a random variable; Expectation and variance of a random variable. **Univariate Discrete Distributions:** Detail study of Bernoulli, Binomial, Poisson, Geometric, Hypergeometric, Negative Binomial, Multinomial, Rectangular distributions. Idea of Logarithmic, Beta Binomial, Generalized Negative Binomial, Negative Hypergeometric, Power Series Distributions. **Univariate Continuous Distributions:** Detail study of Uniform, Exponential, Weibull, Gamma, Beta, Normal, Half Normal, Log Normal, Cauchy distributions. Idea of Inverted Gamma, Inverse Gaussian, Laplace, Logistic, Gumbel, Rayleigh, Maxwell, Erlang, Pareto distributions. Pearsonian system of distributions. **Truncated Distributions:** Study of some special

truncated and censored discrete and continuous distributions. **Elementary Concepts of Bivariate Distribution:** Binomial, Poisson, Geometric, Normal, Gamma and Beta.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Recall fundamental concepts of probability theory, including probability functions, random variables, and various types of generating functions;
CO2	Explain the properties and applications of univariate discrete and continuous distributions, including but not limited to Bernoulli, Binomial, Poisson, Geometric, Hypergeometric, Normal, Exponential, and Gamma distributions;
CO3	Apply appropriate probability distributions, probability generating functions to model, solve, and derive moments and properties for real-world problems;
CO4	Differentiate between various probability models, including truncated and censored distributions, to enhance critical thinking and analytical abilities;
CO5	Assess how different probability distributions relate to each other to determine which models are best for specific datasets, based on their assumptions and characteristics.

Mapping Course Learning Outcomes (COs) with the POs

Course Learning Outcomes (CO)	3: Strong		2: Moderate		1: Weak	
	Fundamental Skill PO 1	Skill PO 2	Social Skill PO 3	Thinking Skill PO 4	Personal Skill PO 5 PO 6	
CO1	1					
CO2	2					
CO3		2				
CO4				2		
CO5				2		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/ Assignment	Mid-term Examination-1, Assignment Evaluation
CO2	Lecture using board/ Assignment	Mid-term Examination-1, Assignment Evaluation, Semester-end examination
CO3	Lecture using board/ Assignment	Assignment Evaluation, Semester-end examination
CO4	Lecture using board/ Assignment	Assignment Evaluation, Semester-end examination
CO5	Lecture using board/ Assignment	Assignment Evaluation, Semester-end examination

Main Texts

1. Krishnamoorthy K., (2006), Handbook of Statistical Distributions with Applications, Chapman and Hall/CRC
2. Johnson, N., Kotz S. and Kemp, A., (2008), Univariate Discrete Distributions, 3rd Edition, John Wiley and Sons, New York
3. Johnson, N. and Balakrishnan N., (1995), Continuous Univariate Distribution, 2nd Edition, John Wiley and Sons, New York
4. Rahman M. S., (2020), Statistics and Probability: An Introductory Analysis, Kazi Prokashoni, Dhaka

Reference Books

1. Devore, J. L., (2011): Probability and Statistics for Engineering and Sciences, 8th Edition, Duxbury Press.
2. Evans, M., Hasting, N. and Peacock, B., (2000): Statistical Distributions, 3rd Edition, Wiley, New York.
3. Hogg, R. V. and Craig, A. T., (2012): Introduction of Mathematical Statistics, 7th Edition, Pearson Education, Asia
4. Islam, M. N., (2006), Introduction to Statistics and Probability, 3rd Edition, Dhaka
5. Ross, S. M., (2014): Introduction to Probability and Statistics for Engineers and Scientist, 5th Edition, Academic Press

6. Roy, M. K., (2011), Fundamentals of Probability & Probability Distributions, ROMAX Publications, Chittagong

Course Code: STA 0542 2153	Credit: 3.0	Year: 2 nd	Semester: 1 st
Course Title: Theory of Statistics		Course Status: Theory	

Rationale of the Course: This course includes inferential statistics such as sampling distribution and hypothesis testing which are the inevitable tools for analyzing statistical data. Students can therefore learn the fundamentals of inferential statistics and use them to evaluate data.

Course Objectives: The objectives of the course are

- Help students conceptualize basic theories in introductory statistical techniques and their applications in different scientific fields,
- Provide solid knowledge regarding parent and sampling distributions,
- Help students develop the capability of testing statistical hypothesis and drawing inference.

Course Contents

Introduction: Concept of parameter and statistic, sampling distribution, transformation of variates, standard errors of statistics. Sampling from normal and non-normal populations, distribution of various statistics. Central limit theorem. Distribution of functions of random variables of continuous and discrete types, joint distribution of \bar{x} and s^2 , detailed study of χ^2 , Student's t and F distributions, distribution of correlation coefficient in the null case, distribution of regression coefficient. **Order statistics:** Properties of order statistics, joint distribution of n order statistics, marginal distributions of order statistics, distribution of the median and range. **Concept of tests of hypothesis:** Hypotheses, errors in testing hypotheses. Testing hypotheses for assigned mean, variance, proportion and correlation. Comparison of means, proportions, variances and correlation, Bartlett's test of homogeneity of variances. Test for correlation and regression coefficients. Exact test for 2×2 table, test for r×c contingency table.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain properties and parameters of relevant parent and sampling distribution;
CO2	Produce appropriate approximation to relevant sampling distribution;
CO3	Formulate appropriate test statistic for testing hypotheses;
CO4	Interpret results in different fields of research.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	1			
CO2	3	1	1			
CO3	3	1	1			
CO4	3	1	1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ semester end examination
CO 2	Lecture using board/ projectors	Quiz/ semester end examination
CO 3	Lecture using board/ Assignment	assignment/presentation (individual/group), mid-term examination
CO 4	Lecture using board/ Tutorial	Quiz/ semester end examination

Main Texts

1. Mood A., Graybill F., Boes D., (1974), Introduction to the Theory of Statistics, 3rd Edition, McGraw Hill, NY
2. Hogg R. V., McKean J., & Craig A. T., (2012), Introduction to Mathematical Statistics, 7th Edition, Pearson

Reference Books

1. Ali M. A., (1973), Theory of Statistics, Vol-II, Dhaka Book Mart
2. David H A, Nagaraja H. N., (2003), Order Statistics, 3rd Edition, Wiley, NY
3. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand and Sons, New Delhi, India

Course Code: STA 0542 2154	Credit: 2.0	Year: 2 nd	Semester: 1 st
Course Title: Theory of Statistics Lab		Course Status: Lab	

Rationale of the Course: Apply acquired knowledge of inferential statistics to analyze data.

Course Objectives: The objectives of the course are

- Acquaint students with the application of fundamental statistical theories,
- Make students capable of analyzing, presenting and interpreting data and results.

Course Contents

Sampling distribution, transformation of variates, standard errors of statistics. Sampling from normal and non-normal populations, distribution of various statistics.

Joint distribution of \bar{x} and s^2 , detailed study of χ^2 , Student's t and F distributions, distribution of correlation coefficient in the null case, distribution of regression coefficient. Testing hypotheses for assigned mean, variance, proportion and correlation. Comparison of means, proportions, variances and correlation, Bartlett's test of homogeneity of variances. Test for correlation and regression coefficients. Exact test for 2×2 table, test for r×c contingency table.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Perform analysis in different fields of study;
CO2	Conduct statistical tests of hypotheses for one sample, two independent samples, two correlated samples and interpret parameters;
CO3	Perform statistical tests of hypotheses for several samples along with interpreting parameters;
CO4	Conduct statistical tests of hypotheses for correlation and regression

	coefficients along with interpreting parameters;
CO5	Perform statistical tests of hypotheses for association of attributes.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	1			
CO2	3	1	1			
CO3	3	1	1			
CO4	3	1	1			
CO5	3	1	1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	
CO 3	Lecture using board/ assignment	
CO 4	Lecture using board/ assignment	
CO 5	Lecture using board/ assignment	

Main Texts

1. Mood A., Graybill F., Boes D., (1974), Introduction to the Theory of Statistics, 3rd Edition, McGraw Hill, NY
2. Hogg R. V., McKean J., & Craig A. T., (2012), Introduction to Mathematical Statistics, 7th Edition, Pearson

Reference Books

1. Ali M. A., (1973), Theory of Statistics, Vol-II, Dhaka Book Mart
2. David H A, Nagaraja H. N., (2003), Order Statistics, 3rd Edition, Wiley, NY
3. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand and Sons, New Delhi, India

Course Code: STA 0542 2156	Credit: 1.5	Year: 2 nd	Semester: 1 st
Course Title: Statistical Computing: C++ & STATA Lab		Course Status: Lab	

Rationale of the Course: To develop analytical skills using C++ programming language and statistical software STATA.

Course Objectives: The objectives of the course are

- Apply and use the basic programming constructs of C++,
- Facilitate necessary skills on data wrangling and exploratory data analysis,
- Assisting the students to use STATA for statistical data analysis.

Course Contents

Basics of C++: Structure of a program, Variables and types, Constants, Operators, Basic Input/Output. **Program structure:** Control Structures, Functions. **Compound data types:** Arrays, Character sequences, Pointers, Dynamic Memory, Data structures, Other data types

Classes: Classes, Special members, Friendship and inheritance, Polymorphism.

Statistical Analysis using STATA: Data entry, data cleaning and data management, graphical representation of data, calculation of different measures of central tendency, dispersion, skewness, kurtosis, different types of correlation, test of hypothesis, application of different linear regression models including model diagnostics.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Demonstrate with the application of Programming Concepts: Establish proficiency in C++ by writing and analyzing programs that incorporate fundamental concepts such as variables, data types, operators, basic input/output, control structures, functions, arrays, pointers, and dynamic memory management.
CO2	Develop along with utilization of Object-Oriented Techniques: Create and manipulate classes in C++ to develop complex applications, leveraging

	special member functions, inheritance, polymorphism, and data structures to solve real-world problems efficiently.
CO3	Perform Data Management and Statistical Analysis: Use STATA to perform comprehensive data management tasks, including data entry, cleaning, and preparation, and generate graphical representations to visualize data insights.
CO4	Conduct Advanced Statistical Tests and Regression Analysis: Apply various statistical methods and hypothesis tests using STATA to interpret data, calculate measures of central tendency, dispersion, skewness, and kurtosis, and implement different linear regression models, including model diagnostics, to draw meaningful conclusions from data.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill PO 1	PO 2	Social Skill PO 3	Thinking Skill PO 4	Personal Skill PO 5 PO 6	
CO1		3		2	2	1
CO2		3		2	2	1
CO3	3	3		2	2	3
CO4		3		2	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/computer/Tutorial using statistical software	Quiz/ Assignment/Lab Reports (Individual/group) Class assessment, Semester-end Examination including Viva-voce
CO 2		
CO 3		
CO 4		

Main Texts

1. Lippman, S., Lajoie, L., and Moo, B., (2013), C++ Primer.
2. Stroustrup, B. (2013). The C++ Programming Language Fourth Edition.
3. Hamilton L. C., (2012), Statistics with Stata, 12th Edition, STATA Bookstore

Reference Books

- 1. Mitchel M. N., A Visual Guide to Stata Graphics, 3rd Edition, STATA Bookstore
- 2. Press W. H., *et al.*, Numerical Recipes in C++: The Art of Scientific Computing, 2nd Edition, Cambridge University Press, UK

Course Code: <u>MAT 0541 2105</u>	Credit: 3.0	Year: 2 nd	Semester: 1 st
Course Title: Advanced Calculus & Differential Equations		Course Status: General Education	

Rationale of the Course: The first section of the course goes over the graphs, limits, continuity, and differentiability of various functions as well as their attributes. The derivative is used to address maximization-minimization problems and problems involving related rates, which have numerous applications in various branches of science and technology. This course also covers multivariable calculus, including partial derivatives, multiple integrals, and their applications. These are used to calculate areas, lengths, surface areas, and volumes.

Course Objectives: The objectives of the course are

- To understand elementary analytical solution techniques for the solution of ordinary differential equations (ODEs),
- To provide the knowledge of linear ODEs in terms of independent homogeneous and non-homogeneous solutions,
- To understand series, including convergence properties and use in representing functions,
- To develop skills on the use of approximation in studying mathematical and scientific problems and the importance of accuracy of approximations.

Course Contents

Advanced Calculus: Concept of improper integrals; Gamma and Beta functions; their incompleteness and other properties; Functions of several variables and limit and continuity; Taylor’s expansion of such functions; maxima and minima of functions of more than one variable; Lagrange’s multipliers; multiple integrals;

Jacobians of transformation; Dirichlet integral and its extension; Laplace transformation; concept of Fourier series, inverse Laplace transformation, Lotka-Volterra integral equation, convolution theorem. **Differential Equations:** Definition; solution of differential equations; basic theory of linear differential equations; basic theory of non-linear differential equations; equations of the first order and their solution; homogeneous differential equations; linear differential equations of the second and higher order and their solution, system of differential equations.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Demonstrate problem-solving skills, including knowledge of techniques for the solution of ODEs;
CO2	Explain the importance of differential equations in the sciences and engineering;
CO3	Determine maximum or minimum value for a function of several variables subject to a given constraint;
CO4	Use integration techniques in finding the consumer’s surplus, producer’s surplus, and exponential growth and decay;
CO5	Solve linear and non-linear differential equations.

Mapping Course Learning Outcomes (COs) with the POs

Course Learning Outcomes (CO)	3: Strong		2: Moderate		1: Weak	
	Fundamental Skill PO 1	PO 2	Social Skill PO 3	Thinking Skill PO 4	Personal Skill PO 5	PO 6
CO1	2			2		
CO2	2			1		
CO3	2			1		
CO4	2			2		
CO5	2			1		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning	Assessment Strategy
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	Strategy	
CO 1	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 4	Lecture using board/ projectors	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Text

Anton H., Bivens I., & Davis S., (2012), Calculus Early Transcendentals, 10th Edition, John Wiley & Sons Inc

Reference Books

1. Thomas G. B., Finney R. L., (1995), Calculus and Analytic Geometry, 9th Edition, Addison Wesley
2. Wrede R., Spiegel M., (2010), Advanced Calculus, 3rd Edition, Schaum's Outlines Series, McGraw-Hill Education
3. Widder D. V., (2012), Advanced Calculus, 2nd Edition, Dover Publications
4. Ross S. L., (1985), Differential Equations, 3rd Edition, John Wiley & Sons, Inc
5. Ayres F., Differential Equations, 3rd Edition, McGraw-Hill Education
6. Sharma B. D., (2001), Differential Equations, Kedar Nath Ram Nath, India

Course Code: ECO 0311 2107	Credit: 3.0	Year: 2 nd	Semester: 1 st
Course Title: Principles of Microeconomics		Course Status: General Education	

Rationale of the Course:

Microeconomics is the branch of economics that focuses on individual agents and their decision-making processes regarding the allocation of limited resources. By

analyzing the forces of supply and demand, students can grasp the mechanisms that shape the allocation of goods and services in society. Moreover, microeconomics provides insights into consumer behavior. By analyzing factors such as preferences, income, and prices, firms can identify and respond to consumer demands, thereby increasing their chances of success in the market. Furthermore, studying microeconomic data analytics enables students to predict efficiency in resource allocation. Finally, microeconomics aids in comprehending the impacts of government policies and regulations. By studying how markets respond to interventions, such as taxes or subsidies, we can assess the intended and unintended consequences on consumers, producers, and overall economic efficiency.

Course Objectives: The objectives of the course are

- To provide a brief and simple introduction to the subject matter and scope of Economics.
- Outlines the theory of markets with relevant applications to business, social and individual issues. The course covers the principles and consequences of “rational” choice by individual economic agents in markets.
- To provide an introductory analysis of the role of governments in seeking to ensure the efficient operation of markets.
- To provide students with a practical understanding of the core economic principles that explain why individuals, companies and governments make the decisions they do, and how their decision-making might be improved to make best use of available resources.

Course Contents

Basic Concepts in Economics: Definition of Economics and Scope, Economic Resources and their Allocation Problems in Economics, Scarcity, Choice, Opportunity Cost, Production Possibilities Frontier (PPF), Understanding Efficiency vs Equity, Economic Principles and Economic Models.

Demand and Supply: Demand- The Law of Demand, the Demand Curve, Factors Affecting the Demand Curve, Shifts versus Movement along the Demand Curve, Elastic and Inelastic Demand, Elasticity and Revenue; **Supply-** The Law of Supply, the Supply Curve, Factors Affecting the Supply Curve, Shifts versus Movement along the Supply Curve, Elasticity of Supply.

Market Equilibrium and Welfare: Interaction of Demand and Supply, Effect on the Equilibrium of a Shift in Demand or Supply or both, Consumer Surplus (CS) and Producer Surplus (PS), Effect of a Tax or Subsidy, Price Controls as a Government Policy: Price Ceiling and Price Floor.

Consumer Behavior: Utility and Choice, Marginal Utility, Law of Diminishing Marginal utility, Indifference Curves and their Properties, Budget Sets, Consumer Equilibrium in Cardinal and Ordinal Approach, Income and Substitution Effects, Deriving the Demand Curve from the Budget Sets and Indifference Map.

Production: Concept of a Production Functions, Total, Average and Marginal Product, Law of Diminishing Returns, Optimum Stage of Production (Production and Employment Decision in the short run), Returns to scale.

Cost and Revenue: Accounting and Economic Cost, Fixed and Variable Costs, Short Run and Long Run Costs, Total, Average and Marginal Costs; Total, Average and Marginal Revenue; Isoquants, Isocosts, and the Least Cost Combination, Equating Marginal Revenue with Marginal Cost.

Perfectly Competitive Markets: Characteristics of Perfectly Competitive Market,Profit Maximization in Short Run and Long Run, Loss, Shut Down, Entry and Exit Conditions.

Imperfectly Competitive Markets: Characteristics and Sources of Monopoly, Production and Pricing Decisions of Monopoly, Oligopoly and Monopolistic Competition, Price Discrimination.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explore the fundamentals of microeconomics and how individual agents make decisions;
CO2	Analyze market demand, supply, elasticity, and determine equilibrium price and quantity;
CO3	Explore consumer behavior, considering budget constraints and price dynamics;

CO4	Examine production and cost structures of firms, and analyze production decisions in both short-run and long-run scenarios;
CO5	Investigate different market structures and the factors influencing pricing decisions within those structures.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		2	3		
CO2			3			3
CO3		3		2		3
CO4			3		2	
CO5				3	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Tutorial	Quiz/ Semester-end examination

Reference Books

1. Case, K. E., Fair, R. C., & Oster, S. E. (2019). Principles of Economics, Global Edition (13th ed.). Pearson.
2. Frank, R., Bernanke, B., Antonovics, K., & Heffetz, O. (2022). Principles of Economics (8th ed.). McGraw-Hill Education.
3. Arnold, R. A. (2018). Economics, Southwestern Publishing Company, Thirteenth Edition
4. Mankiw, N G (2022). Principles of Microeconomics, Thomson South Western Publishing, Ninth Edition
5. Perloff, Jeffrey M. (2015). Microeconomics. Seventh Edition

Course Code: STA 0542 2150	Credit: 1.0	Year: 2 nd	Semester: 1 st
Course Title: Presentation & Viva-voce		Course Status: Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the
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	experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2				2	
CO2	2				3	
CO3	2				3	2
CO4	2				3	3
CO5	1				3	2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Second Year Second Semester Course Details

Course Code: STA 0542 2251	Credit: 3.0	Year: 2 nd	Semester: 2 nd
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Course Title: Regression Analysis – I	Course Status: Theory
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Rationale of the Course: The use of multiple linear regression is explained in detail in this introductory course, which also provides an introduction of several forms of regression. Regression analysis theory, multiple linear regression theory, traditional estimation and testing theory, and residual analysis theory are all covered in this course. Additionally, it covers the creation, analysis, and validation of linear regression models.

Course Objectives: The objectives of the course are

- Familiarize students with the concepts of the statistical modeling,
- Helping students to develop ability in model fitting through estimation of parameters,
- Provide knowledge of assessing fitted model, testing relevant hypotheses and perform forecasting,
- Acquaint students with basic tools of regression models, techniques and interpretations to use in practice.

Course Content

Correlation Analysis: Basic idea of correlation and coefficient of correlation, rank correlation, spurious correlation, non-sense correlation. **Other Techniques of Correlation:** Point-biserial and biserial correlations, Fourfold correlation, polychoric correlation, and intra-class correlation. **Simple Linear Regression:** The concept of population and sample regression functions, method of least squares, estimation of regression coefficients, OLS estimators, and correlation ratio. **Topics on Estimation and Hypothesis Testing:** The classical linear regression model, Gauss-Markov theorem, estimation of error variance, hypothesis testing. **Bivariate Quantitative Data:** Regression curves from bivariate distributions, bivariate normal distribution, marginal distribution, conditional distribution. **Multiple Linear Regression:** Regression through the origin, scaling and units of measures, different functional forms of regression models. Three variable regression, estimation of parameters and standard error, separation of effects, multiple and partial correlation, concepts of polynomial regression. **Residual Analysis:** Basic concepts, analysis of residuals by graphs, lack of fit of model adequacy.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Identify relationships among variables along with assumptions;
CO2	Formulate simple linear regression model with underlying assumptions involved;
CO3	Estimate simple linear regression model parameters along with residual analysis;
CO4	Create multiple linear regression model, regression through origin, and different functional form of regression models;
CO5	Relate appropriate regression models and their limitations in diverse sectors.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2					
CO2	2					
CO3	2					
CO4	2					
CO5	3		3	2	2	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination

CO 3	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 4	Lecture using board/ projectors	Quiz/ Midterm Examination 2
CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Montgomery D. C., Peck E. A., Vining G. G., (2012), Introduction to Linear Regression Analysis, 5th Edition, John Wiley, NY
2. Gujarati, D. N., (2009), Basic econometrics: Tata McGraw-Hill Education
3. Draper N. R. & Smith H., (1998), Applied Linear Regression, 3rd Edition, John Wiley, NY

Reference Books

1. Chatterjee S., & Price P., Regression Analysis by Example, John Wiley, NY
2. Graybil F. A., An Introduction to Linear Statistical Models, Vol-1, McGraw Hill, NY
3. Griffiths W. E., et al., Learning and Practicing Econometrics, John Wiley & Sons, NY
4. Johnston, J., & Di Nardo, J., (2007), Econometric Methods-University of California, Irvine: The McGraw-Hill Companies, Inc.
5. Judge G. G., *et al.*, The Theory and Practice of Econometrics, 2nd Edition, John Wiley & Sons, NY
6. Koutsoyiannis, A., (1979), Theory of Econometrics, The Macmillan Press Ltd, London.
7. Seber G. A. F., General Linear Regression Analysis, Wiley & Sons Ltd, NY
8. Weisberg S., Applied Linear Regression, 2nd Edition, John Wiley, NY

Course Code: STA 0542 2252	Credit: 1.5	Year: 2 nd	Semester: 2 nd
Course Title: Regression Analysis – I Lab		Course Status: Lab	

Rationale of the Course: Apply acquired knowledge to solve practical problems based on the theory learnt. In particular, students can know how to actually use a statistical package to put the theory into practice and address a particular research subject.

Course Objectives: The objectives of the course are

- To demonstrate students how to use correlation theory to measure the strength of relationships among random phenomena,
- To equip students with the tools and techniques to use regression models in practice.

Course Contents

Correlation analysis: Correlation coefficient, rank correlation, biserial correlation, poly-choric correlation, and intra-class correlation. **Simple Linear Regression:** OLS estimators, correlation ratio, hypothesis testing, regression through the origin, scaling and units of measures. **Multiple Linear Regression:** Estimation of parameters and standard error, separation of effects, multiple and partial correlation. **Model Adequacy:** Analyses of residuals by graphs, lack of fit.

Course Learning Outcomes (COs): At the end of course, students will be able to –

CO1	Measure the strength of relationships among random variables;
CO2	Apply linear regression models to estimate the model parameters;
CO3	Interpret model parameters for the given dataset;
CO4	Check model adequacy;
CO5	Find the best fitted regression equation to predict the mean value of a dependent variable.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2					

CO2	2					
CO3	2					
CO4	2					
CO5	3					

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors	
CO 3	Lecture using board/ Assignment	
CO 4	Lecture using board/ Assignment	
CO 5	Lecture using board/ Assignment	

Main Texts

1. Montgomery D. C., Peck E. A., Vining G. G., (2012), Introduction to Linear Regression Analysis, 5th Edition, John Wiley, NY
2. Gujarati, D. N., (2009), Basic econometrics: Tata McGraw-Hill Education
3. Draper N. R. & Smith H., (1998), Applied Linear Regression, 3rd Edition, John Wiley, NY

Reference Books

1. Chatterjee S. & Price P., Regression Analysis by Example, John Wiley, NY
2. Griffiths W. E., et al, Learning and Practicing Econometrics, John Wiley & Sons, NY
3. Koutsoyiannis, A., (1979), Theory of Econometrics, The Macmillan Press Ltd, London.
4. Weisberg S., Applied Linear Regression, 2nd Edition, John Wiley, NY

Course Code: <u>MAT 0541 2203</u>	Credit: 3.0	Year: 2 nd	Semester: 2 nd
Course Title: Numerical Methods		Course Status: General Education	

Rationale of the Course: Acquire knowledge on numerical algorithms.

Course Objectives: The objectives of the course are

- To provide knowledge on numerical methods to solve algebraic and transcendental equations,
- To facilitate necessary knowledge on different methods of interpolations and extrapolations,
- To apply appropriate numerical methods to solve differential equations and to calculate definite integrals,
- To conceptualize the ideas about various numerical root finding methods,
- To equip with various methods of convergence and understand the errors,
- To facilitate necessary knowledge about explaining and understanding of methods to solve the simultaneous equations.

Course Contents

Numerical methods: Interpolation and extrapolation; shifting operators; difference operators and their relationships; Newton's interpolation formulae; Lagrange's formula; Newton's divided difference formula; central difference formulae (Stirling and Bessel's); relationship between divided difference and simple difference; inverse interpolation formula; numerical differentiation; numerical integration by Trapezoidal rule, Simpson's 1/3 and 3/8 rules, Weddle's rule; convergence of these methods and their inherent errors; numerical solution of simultaneous linear equation; by iteration and by successive elimination of the unknowns, Newton-Raphson method; Finding root of single variable equation by different methods.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Illustrate theories and concepts used in numerical analysis;
CO2	Perform numerical differentiation and numerical integration;
CO3	Demonstrate solid data on convergence and errors in approximations;
CO4	Solve systems of simultaneous linear equations;
CO5	Apply Newton-Raphson method to find roots of single variable equation.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2			1		
CO2	2			1		
CO3	2			1		
CO4	2			1		
CO5	2			1		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/projectors	Quiz/ Semester-end examination
CO 4	Lecture using board/Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Text

Scarborough J. B., (2017), Numerical Mathematical Analysis, 6th Edition, Oxford & IBH, New Delhi

Reference Books

- Freeman H., Finite Difference for Actuarial Students, 2nd Edition, Cambridge University Press, UK
- Noble B., Numerical Methods, Vol. I and II

Course Code: <u>MAT 0541 2205</u>	Credit: 3.0	Year: 2 nd	Semester: 2 nd
Course Title: Real Analysis			Course Status: General Education

Rationale of the Course: Acquiring knowledge on open and closed sets, bounded sets, interior point of a set, supremum and infimum, completeness, various types of sequences such as convergent, monotonic and cauchy sequence. Moreover, students will learn different types of infinite series, limit and continuity, derivatives and Riemann integration.

Course Objectives: The objectives of the course are

- To provide the knowledge of real number system,
- To conceptualize the idea of sequences and infinite series,
- To facilitate necessary knowledge on limit and continuity,
- To develop skills on derivatives and Riemann integration.

Course Content

Real number system: Neighborhoods, Open and Closed sets, Bounded sets, Interior point of a set, Limit point of a set, Supremum and infimum, Completeness. **Sequences:** Bounded sequence, Convergent sequence, Monotonic sequence, Cauchy sequence. **Infinite series:** Convergent series, positive term series, Tests for convergence, e.g., comparison test, limit comparison test, ratio comparison test etc. **Limit and continuity:** Limits of functions, Infinite limits, Limits at infinity, Continuous and discontinuous functions, Properties of continuous functions; Uniform continuity. **Derivatives:** Differentiability of functions, Rolle's theorem, Mean value theorem and applications, Taylor's theorem with remainder in Lagrange's forms. **Riemann integration:** Riemann integral, Criterion for integrability, Certain classes of integrable functions, Fundamental theorem of integral calculus.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Describe the fundamental properties of the real numbers that underpin the formal development of real analysis;
CO2	Demonstrate the theory of sequences and series
CO3	Compute limit and continuity;
CO4	Evaluate differentiation and integration;
CO5	Apply skills in constructing rigorous mathematical arguments.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2			1		
CO2	2			1		
CO3	2			1		
CO4	2			1		
CO5	2			1		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ projectors	Quiz/Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/	Assignment/ Presentation

	Assignment	(Individual/group) Semester-end examination
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Main Texts

1. Chatterjee P. N., (1995), Real Analysis, Rajhans Prakashan Mandir, Meerut, India
2. Chowdhury F. & Chowdhury M. R., (2010), Essentials of Real Analysis, Pi Publications, Dhaka
3. Rudin W., (1976), Principles of Mathematical Analysis, McGraw-Hill Book Company

Reference Books

1. Bartle R. G. & Sherbert D. R., (2011), Introduction to Real Analysis, John Wiley & Sons Inc
2. Davidson K. R. & Donsig A. P., (2002), Real Analysis with Real Applications, Prentice Hall Inc
3. Malik S. C. & Arora S., (2009), Mathematical Analysis, New Academic Science Ltd, United Kingdom
4. Mapa S. K., (2006), Introduction to Real Analysis, Sharat Book Distributor, Kolkata, India
5. Trench W. F., (2011), Introduction to Real Analysis, Trinity University San Antonio, Texas, USA

Course Code: ECO 0311 2207	Credit: 3.0	Year: 2 nd	Semester: 2 nd
Course Title: Principles of Macroeconomics		Course Status: General Education	

Rationale of the Course: This course is designed to provide students with a thorough understanding of macroeconomic principles and theories. By focusing on key macroeconomic concepts and their application, students will gain the necessary knowledge and skills to analyze and interpret macroeconomic data, assess Labor market dynamics, evaluate economic growth patterns, explore consumption and saving behavior, investigate investment decisions, examine monetary and banking systems, analyze business cycles, and explore the complexities of monetary and fiscal

policy. Understanding macroeconomic theory is crucial for individuals in economics and finance as it allows them to comprehend the broader economic environment in which businesses operate. By grasping the macroeconomic factors that influence economic conditions, students can make informed decisions regarding macroeconomic strategies and policy implications.

Course Objectives: The objectives of the course are

- The main objective of this course to equip students with a solid foundation in macroeconomic theory, measurement, and analysis, providing them with the necessary tools to assess economic conditions, anticipate market trends, and make sound financial and business decisions.
- The course also aims to foster critical thinking and analytical skills through the examination of real-world macroeconomic issues and case studies.
- Students will be encouraged to apply theoretical concepts to practical scenarios, enabling them to develop macroeconomic problem-solving abilities and enhance their decision-making capabilities.
- Furthermore, the course explores the relationship between inflation and unemployment, which is vital for comprehending the dynamics of the overall economy.
- By studying the factors that drive output, inflation and its impact on employment levels, students will gain insights into the policy challenges faced by policymakers and the potential trade-offs between macroeconomic objectives.

Course Contents

Introduction to Macroeconomics: Macroeconomic principles and objectives; Circular Flow Model and Components of Macroeconomics; Key Macroeconomic Performance Indicators: GDP, GNI, NI and Personal disposable income; Various Methods of GDP Measurement and their Shortcomings; Real vs. Nominal GDP; Growth Rate and Business Cycle.

Determination of National Income: Psychological law of Consumption, Consumption function, Saving and Investment Function, Government and External Sector functions; Leakages and Injections; Equilibrium Output and Multiplier; the Paradox of Thrift.

AD-AS Model: Aggregate Demand Curve-Definition, Shape and Determinants; Aggregate Supply Curve-Definition, Shape and Determinants, Classical vs. Keynesian views on AS Curves; Macro-Equilibrium using AD-AS.

Inflation: Definitions and Types of Inflation; Price Indices—GDP Deflator and CPI; Demand pull and Cost push Inflation; Benefits and Costs of Inflation.

Unemployment: Definitions of Unemployment; Calculation of Labor Force and Unemployment; Causes and Consequences of Unemployment, Remedial Measures and Phillips Curve.

Money, Commercial Banking and Finance: Definition and Functions of Money, Components of Money Supply and Money Demand, Commercial Banks and the Money Creation; Linkage between Macroeconomics and Finance, Causes of Financial Crisis.

Central Banking and Monetary Policy: Structure and Functions of Central Bank, Objectives, Types and Instruments of Monetary Policy; Operation and Lags of Monetary Policy.

Budget and Fiscal Policy: Definition, Objectives, Types and Instruments of Fiscal Policy; Budget, Types of Taxation; Heads of Government Expenditure; Fiscal Policy Multipliers.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Solve equilibrium outcomes in simple models of the Macroeconomics;
CO2	Differentiate between the classical and Keynesian approaches to macroeconomics, synthesizing the underlying theories and their implications for capturing economic phenomena;
CO3	Evaluate macroeconomic theories by comparing their predictions to real-world data, developing the ability to critically assess the validity and applicability of various theoretical frameworks;
CO4	Evaluate macroeconomic policies using the models introduced and developed throughout the course;
CO5	Formulate theoretical frameworks that explain the functioning of unconventional monetary policy under specific economic or financial conditions and their effectiveness and limitations of such policies.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
Learning Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6

(CO)						
CO1	3		2	2		
CO2			2			3
CO3		3		2		3
CO4			3			2
CO5				3	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ projectors	Quiz/ Semester-end examination

Reference Books

1. Case, K. E., Fair, R. C., & Oster, S. E. (2019). *Principles of Economics, Global Edition* (13th ed.). Pearson.
2. Frank, R., Bernanke, B., Antonovics, K., & Heffetz, O. (2022). *Principles of Economics* (8th ed.). McGraw-Hill Education.
3. Arnold, R. A (2018). *Macroeconomics*, South Western Publishing Company, Thirteenth Edition.
4. Mankiw, G. (2022). *Principles of Economics*, Thomson South Western Publishing, Eleventh Edition.

Course Code: <u>CSE 0612 2209</u>	Credit: 2.0	Year: 2 nd	Semester: 2 nd
Course Title: Database Management & Programming		Course Status: General Education	

Rationale of Course: Acquiring basic concepts of database management system and its programming.

Course Objectives: The objectives of the course are

- Provide necessary knowledge on the issues involved in the design and implementation of a database system,
- Helping the students to understand the physical and logical database designs, database modeling, relational, hierarchical and network models,
- Make the students understand the data manipulation language to query, update, and manage a database,
- Helping the students to understand essential DBMS concepts such as: database security, integrity, concurrency, distributed database, Client/Server (Database Server), Data Warehousing,
- Develop skills on design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing and implementing a DBMS.

Course Content

Computer Basics: Concept on Computer Hardware, Software and its classification, networking and Internet. **Introduction to Database:** Database management system, relational database management system, entity-relationship model, relational model, SQL, sorting, indexing, integrity constraints, transaction concept, database system architecture. **Database Management:** Creating a database, opening a database, modifying a database, modifying a database structure, indexing, sorting, searching a database, designing a customer screen, designing a report, designing a menu. **Database Programming:** Programming concept, a simple program, memory variables, constants, operators, commands, arrays, macros, different type of processing, procedures, functions. programming for data entries, update, report, menu and searching.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Describe the fundamentals of database systems;
CO2	Differentiate between different database models;

CO3	Design a relational database including creation of queries in relational databases;
CO4	Use indexing for databases;
CO5	Implement concurrency control mechanisms.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	1			
CO2	2	2	2			
CO3	2	2	1			
CO4	2	2	2			
CO5	2	2	1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Assignment using computer	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ Assignment using computer	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment using	Assignment/ Presentation (Individual/group)

	computer	Semester-end examination
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Main Texts

1. Korth H. F., Sudarshan S., Silberschatz A., (2010), Database System Concepts, McGraw-Hill Education
2. Elmasri R. & Navathe S. B., (2009), Fundamentals of Database Systems, 5th Edition, Pearson Education India

Reference Book

- Ramakrishnan, R., Gehrke, J., & Gehrke, J., (2003), Database management systems, Vol. 3, McGraw-Hill, NY

Course Code: CSE 0612 2211	Credit: 3.0	Year: 2 nd	Semester: 2 nd
Course Title: Database Management & Programming Lab		Course Status: General Education	

Rationale of the Course: Apply acquired knowledge to design and implement database system and SQL.

Course Objectives: The objectives of the course are

- Make the students understand the Windows operating system, word processor, electronic spreadsheet, and presentation software,
- Helping the students to create, modify, indexing, sorting a database, design a customer screen, design a report, designing a menu,
- Helping students to write database programming.

Course Content

Computer Basics: Basic concepts of Windows operating system, word processor, electronic spreadsheet, and presentation software. **Database Management:** Create, modify, indexing, sorting a database, design a customer screen, design a report, designing a menu. **Database Programming:** Basic programming with database.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Perform basic computer operations;
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CO2	Describe the fundamentals of database systems;
CO3	Differentiate between different database models;
CO4	Design a relational database including creation of queries in relational databases;
CO5	Use indexing for databases including implementation of concurrency control mechanisms.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	1			
CO2	2	2	2			
CO3	2	2	1			
CO4	2	2	2			
CO5	2	2	1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ computer	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors	
CO 3	Lecture using board/ projectors	
CO 4	Lecture using board/ computer	
CO 5	Lecture using board/ computer	

Main Texts

1. Korth H. F., Sudarshan S., Silberschatz A., (2010), Database System Concepts, McGraw-Hill Education
2. Elmasri R., & Navathe S. B., (2009), Fundamentals of Database Systems, 5th Edition, Pearson Education India

Reference Book

- Ramakrishnan, R., Gehrke, J., & Gehrke, J., (2003), Database management systems, Vol. 3, McGraw-Hill, NY

Course Code: STA 0542 2250	Credit: 1.0	Year: 2 nd	Semester: 2 nd
Course Title: Presentation & Viva-voce			Course Status: Lab

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- To gain confidence in their own ability to present and explain the basic concepts of the courses,
- To provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2		2		2	
CO2	2		2		3	
CO3	2	2			3	2
CO4	2				3	3
CO5	1	2	2		3	2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Third Year First Semester Course Details

Course Code: STA 0542 3151	Credit: 2.0	Year: 3 rd	Semester: 1 st
Course Title: Design & Analysis of Experiments – I		Course Status: Theory	

Rationale of the Course: Statistical methods are greatly used in experimental studies and serve as essential tools in designing experiments to avoid bias. Moreover, data generated in experimental studies need to be analyzed using various statistical tools and modeling techniques. Therefore, a statistician should have sound knowledge and skills in design and analysis of experiments to conduct any experimental research.

Course Objectives: The objectives of the course are

- To acquaint students with the basic principles and methods of standard experimental design,
- To help students developing the ability to analyze experimental data.

Course Contents

Introduction: Basic ideas of analysis of variance, One-way classification with equal and unequal observations, Two-way and three-way classification with single and multiple observations per cell, Experimental errors and their control, Analysis of variance with fixed effect, random effect and mixed effect models, Model adequacy checking. **Multiple comparison:** Introduction, Tukey's W-test, Newman-Keuls several range test, Duncan multiple range test, Dunnett's test, Bonferroni test. **Experimental designs:** Introduction, Principles of experimental design, uniformity trial, choice of size and shape of plots and blocks, estimation and analysis of completely randomized design, randomized block design and Latin square design. Orthogonality of designs, Analysis of replicated Latin square design, Graceo-Latin square design. **Factorial Experiment:** Introduction to factorial design, factorial experiment for two or three levels up to n factors.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain various concepts of experimental designs and analysis of variance;
CO2	Differentiate various experimental design and other related topics;
CO3	Perform analysis of data generated from different experimental designs;
CO4	Estimate parameters and variance components of different models related to various design of experiments;
CO5	Derive relative efficiencies of various design of experiments.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3		2		

CO2	3	3		2	3	
CO3	3	3		2	3	
CO4	3	3		1	1	
CO5	3	3		2	3	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors/Tutorial	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ projectors/	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Montgomery D. C., (2020), Design and Analysis of Experiments, 10th Edition, Wiley, NY
2. Das M. N., & Giri N. C., (2017), Design and Analysis of Experiments, 3rd Edition, New Age International, Delhi
3. Sahai H., & Ageel, M. I., (2000), The Analysis of Variance: Fixed. Random and Mixed Models, MA: Birkhauser, Boston

Reference Books

1. Bhuyan M. R., Fundamentals of Experimental Design, 2nd Edition, Book World Publications, Dhaka
2. Cochran W. G., & Cox D. R., Experimental Design, 2nd Edition, John Wiley & Sons, NY

3. Davis O. L., Design and Analysis of Industrial Experiments, Oliver & Boyd, London
4. Federer W. T., Experimental Design: Theory and Application, Oxford & IBH Publishing Company, NY
5. Gomez K. A., & Gomez A. A., Statistical Procedures for Agricultural Research, 2nd Edition, Wiley, NY
6. Sheffe H., The Analysis of Variance, John Wiley & Sons, NY
7. Winer B. J., Statistical Principles in Experimental Design, 2nd Ed., McGraw Hill Company, Ltd

Course Code: STA 0542 3152	Credit: 2.0	Year: 3 rd	Semester: 1 st
Course Title: Design & Analysis of Experiments – I Lab		Course Status: Lab	

Rationale of the Course: Apply acquired knowledge for solving the problems on design of experiments.

Course Objectives: The objectives of the course are

- To detect experimental errors and control them,
- To acquaint students with the methods of conducting experiments with standard designs,
- To develop ability to perform factorial design of experiments.

Course Contents

Introduction: One-way classification with equal and unequal observations, Two-way and three-way classification with equal number of observations per cell, Experimental error and interpretation of data, Analysis of variance with fixed effect, random effect and mixed effect models, Model adequacy checking. **Multiple comparison:** Tukey's W-test, Newman-Keuls several range test, Duncan multiple range test, Dunnett's test, Bonferroni test. **Experimental designs:** Estimation and analysis of completely randomized design, randomized block design and Latin square design. **Orthogonality of designs:** Dealing with missing data in experimental design. **Factorial Experiment:** Analysis of factorial experiments for two and three levels.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Perform ANOVA for one-way and two-way classified data;
CO2	Test the equality of treatment means;
CO3	Determine the within group and between group variability;
CO4	Analyze single factor experiments;
CO5	Perform factorial experiments.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong	2: Moderate	1: Weak			
Course Learning Outcomes (CO)	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3			1	
CO2	3	3			1	
CO3	3	3			1	
CO4	3	3			1	
CO5	3	3			1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial/assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors	
CO 3	Lecture using board/ projectors	
CO 4	Lecture using board/ Tutorial/assignment	
CO 5	Lecture using board/ Tutorial/assignment	

Main Texts

1. Montgomery D. C., (2020), Design and Analysis of Experiments, 10th Edition, Wiley, NY
2. Das M. N. & Giri N. C., (2017), Design and Analysis of Experiments, 3rd Edition, New Age International, Delhi
3. Sahai H. & Ageel M. I., (2000), The Analysis of Variance: Fixed. Random and Mixed Models, MA: Birkhauser, Boston

Reference Books

1. Bhuyan M. R., Fundamentals of Experimental Design, 2nd Edition, Book World Publications, Dhaka
2. Davis O. L., Design and Analysis of Industrial Experiments, Oliver & Boyd, London
3. Federer W. T., Experimental Design: Theory and Application, Oxford & IBH Publishing Company, NY
4. Gomez K. A., & Gomez A. A., Statistical Procedures for Agricultural Research, 2nd Edition, Wiley, NY
5. Sheffe H., The Analysis of Variance, John Wiley & Sons, NY
6. Winer B. J., Statistical Principles in Experimental Design, 2nd Ed., McGraw Hill Company, Ltd

Course Code: STA 0542 3153	Credit: 3.0	Year: 3 rd	Semester: 1 st
Course Title: Statistical Inference		Course Status: Theory	

Rationale of the Course: This course covers the basic ideas and methods of statistical inference, such as estimates and testing of single and multiple hypotheses. Additionally, several fundamental concepts in probability theory and random variables will be briefly reviewed.

Course Objectives: The objectives of the course are

- Facilitate necessary knowledge about the techniques for estimating the population parameters,
- Make students understand the properties of point estimates,
- Acquaint students with the basic concepts of interval estimates,
- Help students understand the basic concepts of hypotheses testing using both parametric and non-parametric approaches.

Course Contents

Point estimation: Basic concepts, principles of point estimation. **Properties of point estimators:** Unbiasedness, sufficiency, consistency, efficiency, asymptotic efficiency. Cramer-Rao lower bound, MVB estimate. **Method of point estimation:** Method of maximum likelihood, method of moments, method of least squares, method of

minimum chi-squares, method of minimum variance, and Bayes’ method. **Interval estimation:** Concept of central and non-central confidence interval. Confidence interval for parameters of normal, binomial and Poisson distributions, large sample confidence interval. **Parametric tests:** Review of basic concepts, simple hypothesis & composite hypothesis, Type I error, Type II error, size and power of the test, critical region. Best critical region, Neyman-Pearson fundamental lemma, most powerful tests, uniformly most powerful critical region, UMP tests. **Non-parametric tests:** Tests based on runs, tests of goodness of fit. Rank order statistics. One sample and paired sample techniques. The sign test and signed rank test. General two sample problem. Linear rank statistics and the general two-sample problem. Linear rank tests for the location problem, linear rank tests for the scale problem. Tests of equality of k independent samples. Measures for bivariate samples. Measures of association in multiple comparison.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Define point estimation, interval estimation, parametric test and non-parametric test;
CO2	Estimate the parameters using different techniques of point estimation;
CO3	Construct interval estimation of the parameters using different techniques;
CO4	Investigate the criteria for testing the hypothesis to find the best critical region;
CO5	Formulate the steps involving in testing the non-parametric distributions.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	2		1		
CO2	3	2		1		
CO3	3	2		1		
CO4	3	2		3		
CO5	3	2		1		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ projectors	Quiz/ Semester-end examination

Main Texts

1. Mukhopadhyay, N. (2000). Probability and Statistical Inference, CRC Press
2. Rohatgi, V. K. (2013). Statistical Inference. Dover Publications, Inc.
3. Mood A., Graybill F., Boes D., (1974), Introduction to the Theory of Statistics, 3rd Edition, McGraw Hill, NY

Reference Books

1. Beaumont W., Intermediate Mathematical Statistics, 2nd Edition, Cambridge University Press, London
2. Cox D. R., & Hinkley D. V., Theoretical Statistics, Chapman and Hall, London
3. Graybill F. A., Introduction to Linear Statistical Models, McGraw Hill, NY
4. Hogg R. V., & Craig A. T., Introduction to Mathematical Statistics, Macmillan, NY
5. Hollander M., & Wolf D. A., Nonparametric Statistical Methods, 2nd Edition, John Wiley & Sons, Inc, NY
6. Kendall M. G., & Stuart A., The Advance Theory of Statistics, Vol-2, 4th Edition, Charles-Griffin, London

7. Lindley D. V., The Use of Prior Probability Distributions in Statistical Inference and Decisions, Proceedings of the Fourth Berkeley Symposium on Mathematical Statistics and Probability, Vol 1
8. Zacks S., Theory of Statistical Inference, John Wiley, NY

Course Code: STA 0542 3154	Credit: 2.0	Year: 3 rd	Semester: 1 st
Course Title: Statistical Inference Lab		Course Status: Lab	

Rationale of the Course: Apply acquired knowledge on methods of estimation and tests of hypotheses.

- Course Objectives:** The objectives of the course are
- To acquaint the students with the methods of point estimation,
 - To familiarize the students with the techniques of interval estimation,
 - To help the students developing the ability to perform hypothesis testing using real data.

Course Contents
Drawing sample from univariate and bivariate normal distributions. Point estimation of parameters of univariate distributions by method of moments, method of maximum likelihood and method of least squares. Construction of confidence intervals for parameters of normal distribution, construction of large sample confidence interval for parameters of binomial and Poisson distribution. Tests of hypothesis regarding parameters of univariate and bivariate normal distributions, tests of hypothesis regarding parameters of discrete and continuous distributions. Calculation of best critical region and drawing power curve. Non-parametric tests.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Generate random sample from different distributions;
CO2	Apply point estimation methods to estimate the parameters using the sample from different distributions;
CO3	Construct interval estimation of the parameters using the sample from different distributions;

CO4	Obtain the test with the best critical region;
CO5	Choose a non-parametric test that is suitable under the assumptions of nonparametric distributions.

Mapping Course Learning Outcomes (COs)with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3				
CO2	3	3				
CO3	3	3		2	2	
CO4	3	3		2	2	
CO5	3	3		2	2	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy		
COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors/ assignment	
CO 3	Lecture using board/ projectors/ assignment	
CO 4	Lecture using board/ projectors/ assignment	
CO 5	Lecture using board/ projectors/ assignment	

Main Texts

1. Hogg R. V., & Craig A. T., Introduction to Mathematical Statistics, Macmillan, NY
2. Mood A., Graybill F., Boes D., (1974), Introduction to the Theory of Statistics, 3rd Edition, McGraw Hill, NY

Reference Books

1. Casella G., & Berger R. L., (1990), Statistical Inference, 2nd Edition, Duxbury Thomson Learning, USA
2. Beaumont W., Intermediate Mathematical Statistics ,2nd Edition, Cambridge University Press, London
3. Graybill F. A., Introduction to Linear Statistical Models, McGraw Hill, NY
4. Hollander M., & Wolf D. A., Non-parametric Statistical Methods, 2nd Edition, John Wiley & Sons, Inc, NY
5. Zacks S., Theory of Statistical Inference, John Wiley, NY

Course Code: STA 0542 3155	Credit: 2.0	Year: 3 rd	Semester: 2 nd
Course Title: Statistical Simulation and Data Analysis with R & Python		Course Status: Theory	

Rationale of the Course: In the contemporary environment, it is difficult to envisage and execute any scientific activity without the knowledge of software. Under R & Python programs, students will handle statistical and mathematical operations. Moreover, students will be able to understand built-in functions of R & Python with own programming language that can handle any particular task. Under simulation techniques which will be taught using R software, students will perform basic statistical analysis.

Course Objectives: The objectives of the course are

- Enhancing the skills of basic operations in R and Python,
- Develop ability in solving basic statistical problems using R & Python,
- Foster the analytical and critical thinking ability to write code in R & Python.
- Provide fundamental knowledge on the basic simulation mechanism.

Course Contents

Simulation: Introduction to simulation-concept and meaning of simulation studies and modelling; Basic nature of simulation, discrete and continuous simulation; random number generation, random variate generation details; Series and their convergence; simple Monte Carlo integration, Polynomial and relational functions, incomplete gamma function, incomplete beta function, error function, chi-square probability function, cumulative probability function, exponential integrals, Student’s

t distribution, F distribution, cumulative binomial distribution, hypergeometric distribution, multidimensional function minimization. **R and Python-Language:** Overview of basic operations, list and data frames, data management, grouping, loops and conditional execution, functions; summary statistics and graphical procedures; statistical models with different probability distributions; simulation with R and Python.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Demonstrate along with the application of Simulation Concepts: Students will be able to describe the fundamental concepts and methodologies of simulation studies and modeling, including discrete and continuous simulation, random number generation, and random variate generation.
CO2	Perform Monte Carlo Integration and Function Analysis: Students will be able to perform simple Monte Carlo integration and analyze various mathematical and statistical functions, such as polynomial and relational functions, incomplete gamma and beta functions, error functions, chi-square, Student’s t, F distributions, cumulative binomial, and hypergeometric distributions.
CO3	Implement Simulations using R and Python: Students will gain proficiency in using R and Python for simulation purposes, including data management, grouping, loops, conditional execution, and implementing statistical models with different probability distributions.
CO4	Analyze with the Minimization of Multidimensional Functions: Students will learn techniques for multidimensional function minimization and be able to apply these techniques to real-world data analysis scenarios using appropriate computational tools in R and Python.

Mapping Course Learning Outcomes (COs)with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3		2		

CO2		3			2	2
CO3		3		3	3	3
CO4		3		3	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 4	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination

Main Texts

1. Ross S. M., (2006), Simulation, 4th Edition, Academic Press, London
2. Cohen Y. & Cohen J. Y., (2008), Statistics and Data with R: An applied approach through examples, John Wiley & Sons
3. VanderPlas J., (2016), Python data science handbook: Essential tools for working with data. O'Reilly

Reference Books

1. Crawley M. J., The R Book, 2nd Edition, Wiley, NY
2. Graham C. & Talay D., (2013), Stochastic simulation and Monte Carlo methods: mathematical foundations of stochastic simulation (Vol. 68). Springer Science & Business Media.
3. Ripley D Brian, Stochastic Simulation, Wiley, NY
4. Rubinstein Y R, Simulation and the Monte Carlo Method, Wiley, NY

5. Verzani J, Using R for Introductory Statistics, Chapman & Hall/CRC, NY
6. Rahman M. S., (2017), R Programming and Data Analysis, 1st Edition, Kazi Prokashoni, Dhaka

Course Code: STA 0542 3156	Credit: 1.5	Year: 3 rd	Semester: 2 nd
Course Title: Statistical Simulation and Data Analysis with R & Python Lab			Course Status: Lab

Rationale of the Course: Acquiring skill to perform basic statistical computing algorithms and data analysis using R & Python.

Course Objectives: The objectives of the course are

- Make the students able to conduct basic operations in R and Python,
- Develop ability in solving basic statistical problems using R & Python,
- Foster the analytical and critical thinking ability to write code in R & Python.

Course Contents

R and Python Language: A basic operation in R & Python programming, Data management in R & Python, Graphical representation of data-XY plot, bar chart, pie chart, histogram and so on. **Data analysis using R & Python:** Regression including ANOVA, all possible regressions, sequential methods, model diagnostics, comparisons of regressions, Analysis of randomized block design, treatment comparisons, analysis of non-orthogonal designs, split-plot analysis, Other topics as covered in the theory part.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Master Basic Operations in R and Python: Students will be able to perform basic operations in R and Python, including managing lists and data frames, handling data management tasks, and utilizing loops and conditional execution.
CO2	Utilize Functions and Data Grouping Techniques: Students will be proficient in creating and using functions in R and Python, as well as applying data grouping techniques to organize and analyze datasets

	effectively.
CO3	Generate Summary Statistics with Visualizations: Students will learn to compute summary statistics and create graphical visualizations to represent data insights using R and Python.
CO4	Develop along with the Application of Statistical Models: Students will be able to develop statistical models with different probability distributions and conduct simulations to analyze and interpret data using R and Python.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3		2		
CO2		3			2	2
CO3		3		3	3	3
CO4		3		3	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/computer/tutorial using statistical software	Quiz/ Assignment/Lab Reports (Individual/group) Class assessment, Semester-end Examination including Viva-voce
CO 2		
CO 3		
CO 4		

Main Texts

1. Ross S. M., (2006), Simulation, 4th Edition, Academic Press, London
2. Cohen Y. & Cohen J. Y., (2008), Statistics and Data with R: An applied approach through examples, John Wiley & Sons
3. VanderPlas J., (2016), Python data science handbook: Essential tools for working with data. O'Reilly

Reference Books

1. Crawley M. J., The R Book, 2nd Edition, Wiley, NY
2. Graham C. & Talay D., (2013), Stochastic simulation and Monte Carlo methods: mathematical foundations of stochastic simulation (Vol. 68). Springer Science & Business Media.
3. Ripley D Brian, Stochastic Simulation, Wiley, NY
4. Rubinstein Y R, Simulation and the Monte Carlo Method, Wiley, NY
5. Verzani J, Using R for Introductory Statistics, Chapman & Hall/CRC, NY
6. Rahman M. S., (2017), R Programming and Data Analysis, 1st Edition, Kazi Prokashoni, Dhaka

Course Code: STA 0542 3157	Credit: 3.0	Year: 3 rd	Semester: 1 st
Course Title: Linear Programming			Course Status: Theory

Rationale of the Course: Acquiring knowledge to learn methods for solving linear programming problems. In particular, idea and method for solving the linear programming problem, as well as duality and sensitivity analysis. Moreover, the two person zero sum game is described in the introduction to game theory along with the methods of solution and game theory problems.

Course Objectives: The objectives of the course are

- Foster analytical and critical thinking ability and provide ideas to formulate linear programming problem and theoretical knowledge of solving such type of problems by using appropriate methods,
- Helping the students to develop skills of modeling and optimization of various types (integer and non-integer) of linear programming problem,
- Facilitate necessary knowledge on analyzing the duality and sensitivity problems through different methods,
- Provide knowledge of various methods on game theory and transportation problem.

Course Contents

Elements of linear programming: Formulation of linear programming problems, theorems of linear programming. **Methods of solution:** Graphical method, simplex

method, revised simplex method, primal-dual problems and their solutions, degeneracy and cyclical problems, sensitivity analysis. **Integer linear programming:** Problem formulation, methods of solution, cutting plane algorithm, branch and bound algorithm, transportation problem and its solutions. Decision theory. **Game theory:** Two-person zero sum games. Equivalence of two-person zero sum game and a linear programming problem, methods of solution of the game theory problems.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain the various terminology of linear programming problem;
CO2	Formulate or construct linear programming problem;
CO3	Compare and contrast various linear programming models;
CO4	Identify appropriate methods to solve real life problem;
CO5	Estimate the dual of a linear programming problem to find out primal solution of linear programming problem.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1						
CO2		3			3	
CO3		3		2	2	
CO4		3		3	2	3
CO5		3		3	2	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/	Assignment/ Presentation (Individual/group)

	Assignment	Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/projectors	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Bazaraa M. S., Jarvis J. J., Sherali H. D., (2009), Linear programming and Network flows, 4th Edition, Wiley
2. Taha H. A., (2010), Introduction to Operation Research, 9th Edition, Pearson

Reference Books

1. Charnes V., & Kumar M., Data Envelopment Analysis and Its Applications to Management, Cambridge Scholars Publishing, UK
2. Gass S. I., Linear Programming, 5th Edition, McGraw Hill, NY
3. Hadley G., Linear Programming, Addison-Wesley Publishing Company, USA
4. Ray S. C., Data Envelopment Analysis: Theory and Techniques for Economics and Operations Research, Cambridge University Press, UK;
5. Vajda S., Mathematical Programming, Dover Publications, USA

Course Code: STA 0542 3150	Credit: 1.0	Year: 3 rd	Semester: 1 st
Course Title: Presentation & Viva-voce			Course Status: Lab

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- To gain confidence in their own ability to present and explain the basic concepts of the courses,
- To provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3				3	
CO2	3				3	
CO3	3				3	3
CO4	2				3	3
CO5	1				3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Third Year Second Semester Course Details

Course Code: STA 0542 3251	Credit: 3.0	Year: 3 rd	Semester: 2 nd
Course Title: Stochastic Processes			Course Status: Theory

Rationale of the Course: Acquiring knowledge to model the phenomena and systems that appear to vary not only in a random manner but also with time or any other index.

Course Objectives: The objectives of the course are

- Acquaint students with the concepts of modern probability theory, generating functions, limit theorems and the collection of random variables,
- Facilitate necessary knowledge about Markov chain, derivation of equations and distributions for discrete-state stochastic processes,
- Help students to develop ability to evaluate the characteristics of stochastic systems.

Course Contents

Modern Probability Theory: Borel field and extension of probability measure, probability of a set function, probability measure notion of random variables, probability space, distribution functions. **Generating Functions:** Characteristic

functions and probability generating functions with properties, probability generating functions with properties. **Convergence of Random Variables:** Convergence of random variables, convergence of distribution functions, laws of large numbers, central limit theorems, conditions, Martingales. **Elementary Concepts of Stochastic Process:** Definition, different types of stochastic processes, Markov chain: homogeneous Markov process, transient states, transition matrix, higher transition probabilities, classification of states and chains, ergodic properties. **Finite Markov Chain:** Evaluation of P^n , stability of a Markov system, general theory of random walk with reflecting barriers, absorption probabilities, application of recurrence time, gambler's ruin problem. **Markov Process with Discrete State Space:** Poisson process and its related distributions. **Extension of Poisson Processes:** Generalizations of Poisson process, simple birth process, simple death process, simple birth-death process, general birth process, effect of immigration, non-homogeneous birth death process, recurrent events, renewal equation, delayed recurrent events, number of occurrences of a recurrent event. **Queuing Theory:** Kendall notation, M/M/1, M/M/1/N, M/M/m queues.

Course Learning Outcomes (COs): By the end of the course, students will be expected to -

CO1	Select the suitable probability function for a probability space;
CO2	Define the convergence of a sequence of random variables;
CO3	Formulate non-deterministic systems with Markov chains or Poisson processes and also identification of long-run behavior of chains or processes, especially in environment and business sectors;
CO4	Apply the tools and techniques of queuing systems in public health, transportation and IT sectors to optimize the use of resources.

Mapping Course Learning Outcomes (Cos) with the Pos

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		3			
CO2	3		3	3		
CO3	2		3	3	3	

CO4	1		3	3	3	
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Mapping Course Learning Outcomes (Cos) with the Teaching-Learning & Assessment Strategy

Cos	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1/ Semester-end examination
CO 3	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 4	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Ross S. M., Stochastic Processes, 2nd Edition, Jhon Wiley & Sons, NY
2. Bhat, B. R., (2007), Modern probability theory: New Age International.
3. Medhi, J., (1994), Stochastic processes: New Age International.
4. Sufian A. J. M., (2017), Stochastic Processes and Their Applications in Business, The University Press Limited

Reference Books

1. Roy, M. K., (2000), Fundamentals of Probability and Probability Distributions: Romax Publications.
2. Ross, S. M., (2014), Introduction to probability models: Academic press
3. Ash R. B., Real Analysis and Probability, Academic Press, USA
4. Bailey N. T. J., The Element of Stochastic Processes, Wiley Inter Science Publications, NY
5. Bartlett M. S., An Introduction to Stochastic Processes, 3rd Edition, Cambridge University Press, UK
6. Bhat U. N. & Miller G. K., Elements of Applied Stochastic Processes, 3rd Edition, Jhon Wiley & Sons, NY
7. Billingsley P., Probability and Measure, Anniversary Edition, Jhon Wiley & Sons, NY

8. Chung K. L. & Aitsahlia F., Elementary Probability Theory with Stochastic Processes, 4th Edition, Springer
9. Cox D. R. & Miller W., The Theory of Stochastic Processes, Chapman and Hall, London
10. Grimmett G. R. & Stirzaker D. R., Probability and Random Processes, 3rd Edition, Oxford University Press, UK
11. Karlin S. & Taylor H. M., A First Course in Stochastic Processes, 2nd Edition, Academic Press, NY
12. Taylor H. M. & Karlin S., An Introduction to Stochastic Modeling, 3rd Edition, Academic Press, NYD Irwin Inc, Homewood, Illinois

Course Code: STA 0542 3252	Credit: 2.0	Year: 3 rd	Semester: 2 nd
Course Title: Stochastic Processes Lab		Course Status: Lab	

Rationale of the Course: Securing the ability to solve and discuss dynamic advanced real-life problems based on the theory of stochastic processes.

- Course Objectives:** The objectives of the course are
- Able to apply generating functions and limit theorems,
 - Facilitate necessary skills to formulate Markov chain, derive equations,
 - Develop ability to evaluate the characteristics of stochastic systems.

Course Contents
Probability Theory: Probability measure and Probability space. **Distribution Functions:** Find the different distribution functions. **Generating Functions:** Probability generating functions with properties and applications. **Characteristic functions:** Characteristic functions with properties and applications. **Stochastic Process:** Markov chain: homogeneous Markov process, transient states, transition matrix, higher transition probabilities, classification of states and chains. **Finite Markov Chain:** Evaluation of P^n , stability of a Markov system, general theory of random walk with reflecting barriers, absorption probabilities, application of recurrence time, gambler’s ruin problem. **Applications of Poisson Process:** Birth and death process, M/M/1, M/M/1/N, M/M/m queues.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Select the suitable probability function for a probability space;
CO2	Check the convergence of a sequence of random variables;
CO3	Formulate non-deterministic systems with Markov chains or Poisson processes and also identification of long-run behavior of chains or processes, especially in environment and business sectors;
CO4	Apply the tools and techniques of queuing systems in public health, transportation and IT sectors to optimize the use of resources.

Mapping Course Learning Outcomes (COs)with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		3			
CO2	3		3	3		
CO3	2		3	3	3	
CO4	1		3	3	3	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors	
CO 3	Lecture using board/ assignment	
CO 4	Lecture using board/ assignment	

- Main Texts**
1. Ross S. M., Stochastic Processes, 2nd Edition, Jhon Wiley & Sons, NY
 2. Bhat, B. R., (2007), Modern probability theory: New Age International.
 3. Medhi, J., (1994), Stochastic processes: New Age International.
 4. Sufian A. J. M., (2017), Stochastic Processes and Their Applications in Business, The University Press Limited

Course Code: STA 0314 3253	Credit: 3.0	Year: 3 rd	Semester: 2 nd
Course Title: Demography		Course Status: Theory	

Rationale of the Course: Demographic data is a useful source of knowledge about a nation's socioeconomic development, population trends and growth, and general public health conditions. Demographic data are therefore crucial for both statistics and the field of public health. Therefore, this course focuses on identifying the demographic life events and laying out the steps involved in statistical analysis.

Course Objectives: The objectives of the course are

- To generate knowledge on demographic tools and techniques,
- To facilitate necessary skills to estimate the demographic components and apply the knowledge on policy making.

Course Contents

Basic concept of demography: Demography and population studies, nature and scope of demography, importance of demography, vital statistics, demographic characteristics in Bangladesh. **Sources of demographic data:** Census, survey, population register, sample vital registration system in Bangladesh. Sources and types of errors in demographic data, detection and reduction of errors, the stock and flow data. **Introduction to demographic methods:** Rates, ratios, proportions, cohort, age-sex composition, rates of vital events, errors in age data, detection of errors in age data, population pyramid, concept of population change, rates of population growth and its different measures, balancing equation, history of population growth in Bangladesh. **Fertility and its measures:** Crude birth rate, general fertility rate, age-specific fertility rate, total fertility rate, sex ratio, child woman ratio, cohort fertility rate, marital fertility rate, number of children ever born, cumulative fertility, fertility differentials, gross and net reproduction rate. **Mortality and its measures:** Crude death rate, age-specific death rate, live birth, still birth, neo-natal, infant death rate, infant and child mortality, adjusted infant mortality. **Nuptiality and its measures:** Concept of marriage, divorce, separation, estimation of mean and median age at marriage, estimation of singulate mean age at marriage, nuptiality table. **Standardization of rates and ratios:** Concept, need and methods of standardization.

Life table: Definition, importance and classification, function, construction and application, force of mortality. **Migration:** definition, types of migration, effect of migration, various measures of migration. **Population projections:** Definition, importance, various methods of projection, application and use of different methods of projections with special reference to Bangladesh. **Growth curve:** Fitting of exponential, Gompertz and logistic curve.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Describe various demographic components;
CO2	Explain the demographic process related to various components of demography;
CO3	Analyze the demographic data by troubleshooting the measurement errors including the problem of age heaping;
CO4	Compare and contrast fertility and mortality situation of different regional population by the method of standardization;
CO5	Building capability of various demographic component including population projection under different circumstances.

Mapping Course Learning Outcomes (COs) with the POs

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		1			
CO2			2	3		
CO3				3	3	
CO4			3	3	3	
CO5				2	3	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/	Quiz/ Semester-end examination

	projectors	
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ tutorial	Quiz/ Semester-end examination

Main Texts

1. Kpedekpo G. M. K., (1982), Essentials of Demographic Analysis for Africa, Heinemann, London
2. Islam M. N., (2015), An Introduction to Demographic Techniques, Mullick & Brothers, Dhaka

Reference Books

1. Preston S. H., Heuveline P., Guilot M., (2001), Demography: Measuring and Modeling Population Process, Blackwell Publishers, USA
2. Rowland D. T., (2003), Demographic Methods and Concepts, Oxford University Press Inc., New York, USA
3. Bogue D., Principles of Demography, John Wiley & Sons, NY
4. Cox D. R., Demography, 5th Edition, Cambridge University Press, Cambridge
5. Keyfitz N., Introduction to Mathematics of Population, Addison-Wesley, USA
6. Pollard A. H., et al., Demography, Willey Eastern, India
7. Spiegelman M., Introduction to Demography, Revised edition, Harvard University Press, Cambridge
8. Shryock H. & Siegel J., The Method and Materials of Demography, Academic Press, NY

Course Code: <u>STA 0314 3254</u>	Credit: 2.0	Year: 3 rd	Semester: 2 nd
Course Title: Demography Lab		Course Status: Lab	

Rationale of the Course: Acquiring knowledge to apply various demographic tools and techniques for analyzing real life data.

Course Objectives: The objectives of the course are

- To apply different demographic tools and techniques into real life data,
- To develop necessary skills to provide an estimate of demographic components for proper planning of a nation.

Course Contents

Calculation of various rates, ratios, proportions for demographic data (CBR, CDR, GRR, NRR, TFR, SR, *etc.*) construction of population pyramid, calculation of various measures of population growth, construction of life tables (*complete* and *abridge*), calculation of various measures of population growth, construction of life tables (*complete* and *abridge*), calculation of standardized death rate and ratios, fitting of growth curves. Other topics as covered in the theory part.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Apply various demographic tools and techniques into real life data;
CO2	Construct population pyramid and life table from a set of data;
CO3	Estimate growth rate by using different mathematical models from a set of data;
CO4	Demonstrate projected population of a region;
CO5	Provide appropriate estimates by using primary or secondary data for proper planning of a country.

Mapping Course Learning Outcomes (COs)with the POs

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3		3		
CO2		3		3		
CO3		3		3	3	
CO4					3	3

CO5				2	3	3
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Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ Assignment	
CO 3	Lecture using board/ Tutorial	
CO 4	Lecture using board/ Tutorial	
CO 5	Lecture using board/ Tutorial	

Main Texts

1. Kpedekpo G. M. K., (1982), Essentials of Demographic Analysis for Africa, Heinemann, London
2. Islam M. N., (2015), An Introduction to Demographic Techniques, Mullick & Brothers, Dhaka

Reference Books

1. Preston S. H., Heuveline P., Guilot M., (2001), Demography: Measuring and Modeling Population Process, Blackwell Publishers, USA
2. Rowland D. T., (2003), Demographic Methods and Concepts, Oxford University Press Inc., New York, USA
3. Bogue D., Principles of Demography, John Wiley & Sons, NY
4. Cox D. R., Demography, 5th Edition, Cambridge University Press, Cambridge
5. Keyfitz N., Introduction to Mathematics of Population, Addison-Wesley, USA
6. Pollard A. H., et al, Demography, Willey Eastern, India
7. Spiegelman M., Introduction to Demography, Revised edition, Harvard University Press, Cambridge
8. Shryock H. & Siegel J., The Method and Materials of Demography, Academic Press, NY

Course Code: STA 0542 3256	Credit: 1.5	Year: 3 rd	Semester: 2 nd
Course Title: Data Analysis with SAS (Lab)		Course Status: Lab	

Rationale of the Course: In this course, students will be able to understand the fundamentals of SAS software.

Course Objectives: The objectives of the course are

- Enhancing the skills of basic operations in SAS,
- Develop ability in solving basic statistical problems using SAS,
- Foster the analytical and critical thinking ability to write code in SAS,
- Provide knowledge of properly assessing perfections of a program written in SAS.

Course Contents

Introduction: Overview of SAS Foundation. **SAS Programs:** Introduction to SAS programs, submitting a SAS program, SAS program syntax. **Accessing Data:** Examining SAS data sets, accessing SAS libraries. **Producing Detail Reports:** Sub-setting report data, sorting and grouping report data, enhancing reports. **Formatting Data Values:** Using SAS formats, creating user-defined formats. **Reading SAS Data Sets:** Reading a SAS data set, customizing a SAS data set. **Reading Spreadsheet and Database Data:** Reading spreadsheet data, reading database data. **Reading Raw Data Files:** Introduction to reading raw data files, reading standard delimited data, reading nonstandard delimited data, handling missing data. **Manipulating Data:** Using SAS functions, conditional processing. **Combining Data Sets:** Concatenating data sets, merging data sets one-to-one, merging data sets one-to-many, merging data sets with nonmatches. **Creating Summary Reports:** Using the FREQ procedure, using the MEANS and UNIVARIATE procedures, using the Output Delivery System. **SAS Procedures:** PROC steps–PRINT, SORT, FORMAT, MEANS, UNIVARIATE, TABULATE, CORR, SUMMARY, CONTENTS, TRANSPOSE, FREQ, T-TEST, ANOVA, GLM, REG, POT, SAS graphics.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Identify SAS Program Structure along with Data Access: Students will study the fundamentals of SAS programs, including program syntax and how to submit a SAS program. They will also figure out how to examine SAS data sets and access SAS libraries;
CO2	Produce with the Enhancement of Detail Reports: Students will be able to produce detailed reports by sub-setting, sorting, and grouping report data.

	They will also study how to enhance reports using various formatting techniques, including SAS formats and user-defined formats;
CO3	Read along with the Manipulation of Data from Various Sources: Students will develop the skills to read and customize SAS data sets, read spreadsheet and database data, and handle raw data files, including both standard and nonstandard delimited data and missing data. They will also study how to manipulate data using SAS functions and conditional processing;
CO4	Combine Data Sets with Summary Reports: Students will be able to combine data sets using concatenation and merging techniques (one-to-one, one-to-many, and nonmatches). Additionally, they will study how to create summary reports using various SAS procedures such as FREQ, MEANS, UNIVARIATE, and the Output Delivery System, as well as other key SAS procedures for data analysis and graphics.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3			2	2
CO2		3		3	3	3
CO3		3		3	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/computer/tutorial using statistical software	Quiz/ Assignment/Lab Reports (Individual/group) Class assessment, Semester-end Examination including Viva-voce
CO 2		
CO 3		

Main Texts

1. Der G. & Brian S. E., (2008), A Handbook of Statistical Analyses Using SAS, 3rd Edition, CRC Press

Reference Books

1. Cody R., SAS® by Example: A Programmer's Guide, SAS Institute
2. Cody R., SAS® Functions by Example, 2nd Edition, SAS Institute
3. Cody R., SAS® Statistics by Example, SAS Institute
4. Raithel M. A., How to Become a Top SAS® Programmer, SAS Institute

Course Code: STA 0542 3257	Credit: 3.0	Year: 3 rd	Semester: 2 nd
Course Title: Regression Analysis – II			Course Status: Theory

Rationale of the Course: Providing students with a comprehensive understanding of the advanced statistical tools employed for linear regression.

Course Objectives: The objectives of the course are

- To provide a thorough foundation for general linear regression model,
- To facilitate necessary knowledge on fitting regression models,
- To provide knowledge of understanding sampling distribution of parameter estimates,
- To foster analytical and critical thinking ability to carry out hypothesis tests and model diagnostics,
- To enhance skills of alternative model fitting in case of violation of classical assumptions.

Course Contents

Multiple regression and linear estimation: Generalized and weighted least squares. Gauss-Markov Aitken's theorem. Estimation and tests for linear restriction. **Heteroscedasticity:** Detection and testing for heteroscedasticity, estimation with heteroscedastic disturbances. **Multicollinearity:** Concept of exact and near multicollinearity, estimable functions, effects of multicollinearity, detection and remedial measures of multicollinearity. Selection of variables. **Autocorrelation:** Sources and consequences of autocorrelation, tests for autocorrelated disturbances,

estimation of parameters. **Dummy variables:** General concepts, use of dummy variables in regression analysis. **Errors in variables:** Basic ideas, consequences and tests for error in variables, estimation of parameters, errors in equation. Errors in equation.

Course Learning Outcomes (COs): At the end of course, students will be able to –

CO1	Recall simple linear regression model with model assumptions;
CO2	Fit multiple linear regression model along with checking the model assumptions;
CO3	Transform predictors and response variables to improve model fit;
CO4	Assess parameter estimates globally, in subsets, and individually;
CO5	Deal with categorical predictors and interactions among predictors.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3				
CO2	3	3				
CO3	3	3		2		
CO4	3	3		2	3	
CO5	2	3		3	2	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 2	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 1

		Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Tutorial	Quiz/Semester-end examination

Main Texts

1. Gujarati D. N., (2009), Basic Econometrics, 3rd Edition, McGraw Hill, NY
2. Johnston J., (1979), Econometric Methods, McGraw Hill, NY
3. Neter, J., *et al*, (1983), Applied Linear Regression Models, Richard D Irwin Inc, Homewood, Illinois

Reference Books

1. Chatterjee S., & Price B., (2012), Regression Analysis by Example, 5th Edition, John Wiley & Sons, NY
2. Draper N. R. & Smith H., (1998), Applied Regression Analysis, 3rd Edition, John Wiley & Sons, NY
3. Griffiths W. E., *et al*, (1994), Learning and Practicing Econometrics, 1st Edition, John Wiley & Sons, NY
4. Judge, G. G., *et al*, (1985), The Theory and Practice of Econometrics, 2nd Edition, John Wiley & Sons, NY
5. Koutsoyiannis, A., (2001), Theory of Econometrics, 2nd Edition, Macmillan, London
6. Montgomery, D. C., & Peck, E. A., (2012), Introduction to Linear Regression Analysis, John Wiley & Sons, NY

Course Code: STA 0542 3258	Credit: 2.0	Year: 3 rd	Semester: 2 nd
Course Title: Regression Analysis – II Lab		Course Status: Lab	

Rationale of the Course: Apply acquired empirical knowledge of fitting multiple linear regression models through data.

Course Objectives: The objectives of the course are

- Familiarize students with the skills of fitting multiple linear regression models,
- Helping the students to test multi-collinearity, autocorrelation in data and fitting models after removing those problems,
- Make the students able to fit models with dummy variables and perform tests of hypotheses.

Course Contents

Fitting of multiple regression models, tests of parameters of a multiple regression model. Detection and tests for heteroscedasticity, multi-collinearity, fitting of model after removing these problems. Tests of autocorrelation and estimation of parameters with auto-correlated disturbances. Fitting of dummy variables model and tests.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Fit multiple linear regression model along with checking the model assumptions;
CO2	Detect violation of assumptions and possible soultions;
CO3	Transform predictors and response variables to improve model fit;
CO4	Formulate and solution of models with dummy variables;
CO5	Perform tests of hypotheses of regression parameters.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3			1	
CO2	3	3			1	
CO3	3	3		2	1	
CO4		3		3	2	
CO5	3	3			2	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2		
CO 3		
CO 4		
CO 5		

Main Texts

1. Gujarati D. N., (2009), Basic Econometrics, 3rd Edition, McGraw Hill, NY
2. Johnston J., (1979), Econometric Methods, McGraw Hill, NY
3. Neter, J., *et al*, (1983), Applied Linear Regression Models, Richard D Irwin Inc, Homewood, Illinois

Reference Books

1. Chatterjee S., & Price B., (2012), Regression Analysis by Example, 5th Edition, John Wiley & Sons, NY
2. Draper N. R. & Smith H., (1998), Applied Regression Analysis, 3rd Edition, John Wiley & Sons, NY
3. Griffiths W. E., *et al*, (1994), Learning and Practicing Econometrics, 1st Edition, John Wiley & Sons, NY
4. Judge, G. G., *et al*, (1985), The Theory and Practice of Econometrics, 2nd Edition, John Wiley & Sons, NY
5. Koutsoyiannis, A., (2001), Theory of Econometrics, 2nd Edition, Macmillan, London
6. Montgomery, D. C., & Peck, E. A., (2012), Introduction to Linear Regression Analysis, John Wiley & Sons, NY

Course Code: STA 0542 3259	Credit: 1.0	Year: 3 rd	Semester: 2 nd
Course Title: Field Work			Course Status: Capstone

Rationale of the Course: Acquiring practical experience of collecting data with a tour to an industry or organization or institution or by a field visit can help student gain some real life skills of data collection, collaboration and networking.

Course Objectives: The objectives of the course are

- Provide students with hands-on experience of collecting data from various sources,
- Facilitate students to develop industry-academia collaboration and networking.

Course Contents

The topic and location of the field work will be decided by a general meeting of the teachers of the department. A small group of students will be assigned to teachers by the department for supervision. The evaluation will be made jointly by supervisors and chairman of the respective examination committee. All students will have to submit a written report through their assigned teachers to the department.

Reference Books

Recommended readings and books referred by the supervisors of the field work.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Conduct field survey to collect necessary data from relevant sources;
CO2	Apply appropriate sampling technique to obtain a representative sample;
CO3	Develop effective collaboration with various industries, organizations and institutions to collect necessary data for the betterment of their future job placement;
CO4	Illustrate hands-on experience of physically visiting the field of study and having direct interaction with the study subjects or experimental units;
CO5	Prepare field work report including dissemination of the outcome from the field works report.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6

(CO)						
CO1		3			2	2
CO2		3		2	2	2
CO3			3	2	3	3
CO4		3	3		3	2
CO5		3	2	2	3	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Field demonstration	Semester-end presentation/oral examination and evaluation of written report
CO 2	Field demonstration	Semester-end presentation/oral examination and evaluation of written report
CO 3	Field demonstration	Semester-end presentation/oral examination and evaluation of written report
CO 4	Field demonstration	Semester-end presentation/oral examination and evaluation of written report
CO 5	Field demonstration	Semester-end presentation/oral examination and evaluation of written report

Course Code: STA 0542 3250	Credit: 1.0	Year: 3 rd	Semester: 2 nd
Course Title: Presentation & Viva-voce		Course Status: Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through

presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs)with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes (CO)	Fundamental Skill		Social Skill		Thinking Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		3		3	
CO2	3		3		3	

CO3	3	3			3	3
CO4	2				3	3
CO5	1	3	3		3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Fourth Year First Semester Course Details

Course Code: STA 0542 4151	Credit: 3.0	Year: 4 th	Semester: 1 st
Course Title: Economic Statistics			Course Status: Theory

Rationale of the Course: In order to undertake empirical economic research, a variety of economic approaches are covered in this course. Models for panel data, income distribution model, cobb-Douglas production function are some of the subjects covered. Therefore, this course provides students to acquire knowledge on the statistical methods of analyzing economic data.

Course Objectives: The objectives of the course are

- Make the students understand the concept of consumer and producer behavior,
- Acquaint students with the knowledge of national income and wealth distributions and their inequalities,
- Provide knowledge of productivity and its functional form,

- Understand the link between inter sector productivity,
- Familiarize students with the concepts of different growth models.

Course Contents

Attributes of consumer behavior: Engel curves and lognormal demand curves. Maximization of utility, demand function, price, income and cross elasticities of demand. Preference theory of demand. **Distribution of personal income:** Empirical distribution, Pareto's law, Lorenz curve, Concentration ratio, The lognormal distribution, Stochastic model of income distribution.

Index number: Problems in construction of index numbers, purpose of the index, price index, Quantity index, value index, tests of index numbers, cost of living index, family budget method.

Time series: General ideas, Decomposition, Trend, Seasonality. Different methods of finding trends & seasonality.

Theory of production: Production function, concepts of average productivity, marginal productivity, marginal rate of technical substitution, efficiency of production, factor intensity, returns to scale and homogeneity of production function, production possibility curve, cost function, minimizing cost for a given level of output, maximization of profit subject to constraint cost, maximization of profit for a given output, Cobb-Douglas production function, constant elasticity substitution (CES) production function. **Dynamic economics:** Cobweb model, Harrod-Domar model of economic growth, Natural and non-natural technical change, two sector growth models. **Input-output analysis:** Meaning of input output, main features of input output, assumptions, Leontiefs static and dynamic model, limitations, importance and application of the analysis.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain the concerns surrounding consumer behavior, income and wealth inequalities, characteristics, and indicators;
CO2	Describe time series analysis, index numbers, income inequalities and different types of economic models;
CO3	Optimize production and cost functions;
CO4	Evaluate inter-industrial relationships for productivity;
CO5	Apply different growth models in development planning.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		2	3			
CO2	2		3			
CO3		3	3	2	2	
CO4			3	2	2	
CO5		3		2	3	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/Mid-term Examination-1 Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/Semester-end examination
CO 5	Lecture using board/ Assignment	Assignment/Presentation (individual/group), Mid-term Examination-2, Semester-end examination

Main Texts

1. Allen R. G. D., (1970), Mathematical Economics, MacMillan, London
2. Chiang A. C., Wainwright K., (2005), Fundamental Methods of Mathematical Economics, 4th Edition, McGraw Hill, NY
3. Singh S. P., Parashar A. K., Singh H. P., (1999), Econometrics and mathematical economics, S. Chand and Company, 7th Revised Edition

Reference Books

1. Bridge J. L., Applied Econometrics, North Holland, Amsterdam
2. Chatfield C., The Analysis of Time Series: An Introduction, 6th Edition, Chapman & Hall, London
3. Gupta S. C. & Kapoor V. K., Fundamentals of Applied Statistics, 4th Reprint Edition, Sultan Chand & Sons, New Delhi
4. Henderson J. M. & Quandt R. E., Microeconomic Theory: A Mathematical Approach, 3rd Edition, McGraw Hill, NY
5. Kakwani N. C., (1980), Income Inequality and Poverty: Methods of Estimation and Policy Application, A World Bank Research Publication by Oxford University Press
6. Klein L. R., An Introduction to Econometrics, Literary Licensing, LLC
7. Koutsoyiannis A., Modern Microeconomics, 2nd Edition, Macmillan, London

Course Code: STA 0542 4152	Credit: 2.0	Year: 4 th	Semester: 1 st
Course Title: Economic Statistics Lab		Course Status: Lab	

Rationale of the Course: Apply acquired knowledge on the statistical methods of analyzing economic data.

Course Objectives: The objectives of the course are

- Make the students to fit demand curves,
- Helping the students to calculate price and income elasticity of demand,
- Provide the knowledge to fit income and wealth distributions and also to estimate income and wealth inequalities,
- Helping the students to estimate various production functions.

Course Contents

Computation of price and income elasticity of demand, fitting demand curves, fitting Engel's curves, fitting of Pareto and lognormal distribution, Lorenz curve and Gini's concentration ratio, estimation of production functions: Cobb-Douglas (CD), CES, trans-log, generalized forms of CD and CES production functions. Maximization of

production function, Minimization of cost function, Construction of Input output table and its interpretation, Fitting different economic growth curves.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Compute price and income elasticity of demand, income and wealth inequalities;
CO2	Fit demand curves, Engel's curve, income distributions, and different economic growth curves;
CO3	Estimate the parameters of the production functions along with their interpretations.
CO4	Conduct different input-output analysis.

Mapping Course Learning Outcomes (COs) with the POs

	3: Strong	2: Moderate	1: Weak			
Course Learning Outcomes (CO)	Fundamental Skill PO 1	Skill PO 2	Social Skill PO 3	Thinking Skill PO 4	Personal Skill PO 5	Skill PO 6
CO1		3	2		2	
CO2		3	2	2	2	
CO3		3	3	2	2	
CO4		3		3	2	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial/Assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2		
CO 3		
CO 4		

Main Texts

1. Allen R. G. D., (1970), Mathematical Economics, MacMillan, London

- Chiang A. C., Wainwright K., (2005), Fundamental Methods of Mathematical Economics, 4th Edition, McGraw Hill, NY
- Singh S. P., Parashar A. K., Singh H. P., (1999), Econometrics and mathematical economics, S. Chand and Company, 7th Revised Edition

Reference Books

- Bridge J. L., Applied Econometrics, North Holland, Amsterdam
- Chatfield C., The Analysis of Time Series: An Introduction, 6th Edition, Chapman & Hall, London
- Gupta S. C. & Kapoor V. K., Fundamentals of Applied Statistics, 4th Reprint Edition, Sultan Chand & Sons, New Delhi
- Kakwani N. C., (1980), Income Inequality and Poverty: Methods of Estimation and Policy Application, A World Bank Research Publication by Oxford University Press
- Klein L. R., An Introduction to Econometrics, Literary Licensing, LLC
- Koutsoyiannis A., Modern Microeconomics, 2nd Edition, Macmillan, London

Course Code: STA 0542 4153	Credit: 3.0	Year: 4 th	Semester: 1 st
Course Title: Applied Statistics		Course Status: Theory	

Rationale of the Course: The goal of statistics is to derive meaning from data. In order to perceive the relationships in the data and use systematic methods to comprehend the links using mathematics, this course will cover approaches for data collection, presentation, and summarization. Therefore, students can acquire knowledge to the key areas of official statistics, industrial statistics and educational statistics.

Course Objectives: The objectives of the course are

- Acquaint students with statistical tools for quality control in industry,
- Facilitate necessary knowledge on various statistical tools to analyze educational and psychological data,
- Develop skills to collect, analyze and represent quantitative and qualitative information in the official statistics.

Course Contents

Statistical quality control: Process and product control, Meaning of quality, Components of quality, Factors affecting the quality, Quality control, Chance and assignable causes of variations, Concept of statistical quality control (SQC), Uses of SQC, Control charts, 3-sigma control limits, Tools for SQC-control charts for variables and attributes: control charts for mean, range, standard deviation; p -chart or control chart for fraction defective, d -chart or control chart for number of defectives; Control chart for number of defects per unit or c -chart. Natural tolerance limits and specification limits-modified control limits.

Acceptance sampling by attributes: Acceptance quality level (AQL), Lot tolerance proportion or percent defective (LTPD), Process average fraction defective, Consumer's risk, Producer's risk, Rectifying inspection plans, Average outgoing quality limit (AOQL), Operating characteristic (OC) curve, Average sample number (ASN), Average amount of total inspection (ATI). Dodge and Romig rectifying sampling inspection plans-detail study of single, double and sequential sampling plans.

Psychological and educational statistics: Introduction, Scaling individual test items in terms of difficulty (sigma-scaling), Scaling of scores on a test-Z (or sigma) score and Z (or sigma) scaling, standard scores, normalised scores, T -scores; Percentile scores, Scaling of rankings in terms of normal probability curve, Scaling of ratings in terms of normal curve, Reliability of test scores, Coefficient of reliability, Error variance or standard error of measurement, Index of reliability, Parallel tests, Methods of determining test reliability-the test-retest method, alternate or parallel forms method, split-half method, the Rulon method, method of rational equivalence or Kuder-Richardson formula; Effects of test length and different ranges on the reliability of test; Validity of test scores, Calculation of validity, Comparison between reliability and validity, Intelligence Quotient (IQ).

Published Statistics in Bangladesh: Official, semi-official and non-official statistics, Sources of published statistics in Bangladesh, Listing of important statistical publications of Bangladesh with organisations, frequencies and main coverages, Types of classification of statistics in Bangladesh, Limitations of

published statistics of Bangladesh and recommendation for increasing the quality.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain statistical quality control, control chart, 3-sigma control limits, sampling inspection by attributes, test in education and psychology, scaling individual test items, scaling of scores, reliability and validity of test scores, Intelligence quotient; official, semi-official and non-official statistics;
CO2	Describe the techniques for statistical quality control, various sampling inspection plans with related concepts, methods of determining test reliability and validity, published statistics in Bangladesh;
CO3	Determine the mathematical expressions for control limits and curves associated with control charts and sampling inspection plans respectively;
CO4	Differentiate process control from product control, control chart for variables from control chart for attributes, reliability of test scores from validity of test scores.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	3			
CO2	3	3		2		
CO3	3	3		2		
CO4	3	3	3			

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
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CO 1	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Mid-semester examination 1 Semester-end examination
CO 2	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Mid-semester examination 2 Semester-end examination
CO 3	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Semester-end examination
CO 4	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Semester-end examination

Main Texts

1. Leavenworth, R. S., & Grant, E. L. (2004), Statistical Quality Control, 7th Edition, Tata McGraw Hill, India
2. Guilford J. P. & Benjamin F., (1977), Fundamental Statistics in Psychology and Education, 6th Edition, McGraw Hill

Reference Books

1. Banks J., Principles of Quality Control, 1st Edition, Wiley
2. Duncan A. J., Quality Control and Industrial Statistics, 5th Edition, Irwin Publication
3. Guilford J. P., Psychometric Methods, McGraw Hill, NY
4. Gupta S. C., Kapoor V. K., Applied Statistics, Sultan Chand & Sons, New Delhi, India
5. Publications of BBS, Bangladesh Bank, NIPORT and Other Organizations
6. Wordsworth H. M., *et al*, Modern Methods for Quality Control and Improvement, 2nd Edition, Wiley
7. Biswas, S., Statistics of quality control, new central book agency.

Course Code: STA 0542 4154	Credit: 1.5	Year: 4 th	Semester: 1 st
Course Title: Applied Statistics Lab		Course Status: Lab	

Rationale of the Course: Application of acquired knowledge to the key areas of industrial statistics and educational statistics.

Course Objectives: The objectives of the course are

- Make the students able to use statistical tools for quality control in industry,
- Help the students to analyze educational and psychological data using statistical tools.

Course Contents:

Control charts for mean, range, standard deviation; *p*-chart, *d*-chart, *c*-chart, modified control limits. OC, ATI, AOQ curves for single sampling plan; Determination of LTFD, AOQL for single sampling plan; OC, ASN curves for double and sequential sampling plans; Scaling individual test items in terms of difficulty, Scaling of scores on a test- Z-scores, standard scores, normalised scores, *T*-scores; Percentile scores, Scaling of rankings and ratings in terms of normal curve, Determining the coefficient of reliability of test scores.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Calculate control limits associated with control charts, modified control limits, and OC, ASN, ATI, AOQ for various sampling inspection plans using industrial data;
CO2	Draw control charts, and OC, ASN, ATI, AOQ curves for various sampling inspection plans;
CO3	Determine difficulty value of test items; test scores, percentile scores, coefficient of reliability using educational and psychological data;
CO4	Interpret industrial, educational and psychological data.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	3			

CO2	3	3		2		
CO3	3	3		2		
CO4	3	3		2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projector Assignment	Assignment/evaluation/class test (Individual/group) Semester-end examination
CO 2	Lecture using board/ projector Assignment	
CO 3	Lecture using board/ projector Assignment	
CO4	Lecture using board/ projector Assignment	

Main Texts

1. Leavenworth, R. S., & Grant, E. L., (2004), Statistical Quality Control, 7th Edition, Tata McGraw Hill, India
2. Guilford J. P. & Benjamin F., (1977), Fundamental Statistics in Psychology and Education, 6th Edition, McGraw Hill

Reference Books

1. Banks J., Principles of Quality Control, 1st Edition, Wiley
2. Duncan A. J., Quality Control and Industrial Statistics, 5th Edition, Irwin Publication
3. Guilford J. P., Psychometric Methods, McGraw Hill, NY
4. Gupta S. C., Kapoor V. K., Applied Statistics, Sultan Chand & Sons, New Delhi, India
5. Publications of BBS, Bangladesh Bank, NIPORT and Other Organizations

6. Wordsworth H. M., *et al*, Modern Methods for Quality Control and Improvement, 2nd Edition, Wiley

Course Code: STA 0542 4155	Credit: 3.0	Year: 4 th	Semester: 1 st
Course Title: Design & Analysis of Experiments – II		Course Status: Theory	

Rationale of the Course: The theories and methods employed in the factorial design are covered in this course. The course looks at factorial experiment design, execution, and data analysis. This course includes covers nested and split designs, as well as experiments with random components. Therefore, students will be able to acquire knowledge on advanced design of experiments.

Course Objectives: The objectives of the course are

- To facilitate necessary knowledge about estimable function and tests of hypothesis,
- To foster the analytical and critical thinking ability to prepare layout and analyze data from incomplete block design of experiments,
- To provide knowledge on layout and analysis of confounded factorial design of experiments,
- To provide knowledge of asymmetric factorial designs,
- To develop skills on analysis of covariance.

Course Contents

Estimation: Linear estimation, estimable parametric functions and conditions for estimability, methods of estimation for analysis of variance models, solution of normal equations for less than full rank, optimality properties of least squares estimators, test of hypothesis. **Weighing design:** method of estimation. Use of incomplete blocks, construction and analysis of BIB designs, incomplete block design as weighting designs (intra and inter-block analysis). Missing plot. Orthogonal Latin squares. Youden squares. Lattice designs. Partially balanced incomplete block designs. **Factorial experiment:** sⁿ factorial experiments and their analysis. Confounding, total, partial and simultaneous confounding in two and three levels up to n factors, fractional replicates and their construction. Asymmetric factorial experiments. **Split-plot design:** analysis of split-plot design, split-split-plot design:

analysis of split-split-plot design. **Strip-plot design:** Analysis of strip-plot design, nested design: analysis of nested design. **Analysis of covariance:** analysis of covariance of non-orthogonal data in two-way classification. Analysis of covariance with one and more than one ancillary variables. Covariance and analysis of experiments with missing observations, transformation.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain estimable function including identification of conditions of estimability;
CO2	Layout incomplete block design of experiments and its analysis;
CO3	Prepare confounded factorial experiment and advanced experimental designs along with the analysis of data from such designs;
CO4	Outline asymmetrical experimental design and its analysis;
CO5	Formulate analysis of covariance (ANCOVA) model along with its analysis.

Mapping Course Learning Outcomes (COs)with the POs

Course Learning Outcomes (CO)	3: Strong		2: Moderate		1: Weak	
	Fundamental Skill PO 1	PO 2	Social Skill PO 3	Thinking Skill PO 4	Personal Skill PO 5	PO 6
CO1	2	3				
CO2	3	3		2	2	
CO3	3	3				
CO4	2	3		2	2	
CO5	3	2			3	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/	Quiz/ Midterm Examination 1

	tutorial	Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Montgomery D. C., (2020), Design and Analysis of Experiments, 10th Edition, Wiley, NY
2. Lawson, J. (2015), Design and Analysis of Experiments with R, Chapman and Hall/CRC

Reference Books

1. Bhuyan M. R., Fundamentals of Experimental Design, 2nd Edition, Book World Publications, Dhaka
2. Das M. N. & Giri N. C., (2017), Design and Analysis of Experiments, 3rd Edition, New Age International, Delhi
3. Sahai H. & Ageel, M. I., (2000), The Analysis of Variance: Fixed. Random and Mixed Models, MA: Birkhauser, Boston
4. Cochran W. G. & Cox D. R., Experimental Design, 2nd Edition, John Wiley & Sons, NY
5. Federer W. T., Experimental Design: Theory and Application, Oxford & IBH Publishing Company, NY
6. Gomez K. A. & Gomez A. A., Statistical Procedures for Agricultural Research, 2nd Edition, Wiley, NY
7. Kempthorne O., The Design and Analysis of Experiment, Reprint Edition, Wiley, NY
8. Winer B. J., Statistical Principles in Experimental Design, 2nd Ed., McGraw Hill Company, Ltd

9. Yates F., Design and Analysis of Factorial Experiments, Harpenden Herts, England

Course Code: STA 0542 4156	Credit: 2.0	Year: 4 th	Semester: 1 st
Course Title: Design & Analysis of Experiments – II Lab			Course Status: Lab

Rationale of the Course: Solving the problems on advanced design of experiments.

Course Objectives: The objectives of the course are

- Make the students able to conduct confounded factorial design of experiments,
- Assist the students to perform incomplete block design of experiments,
- Help the students able to analyze asymmetric factorial designs,
- Make the students capable to perform analysis of covariance.

Course Contents

Total, partial and simultaneous confounding, fractionally replicated factorial experiment, intra block and inter block analysis of BIBD, analysis of split-plot design, split-split plot design, strip- plot design and nested design, analysis of covariance.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Apply the confounded factorial experiment and advanced experimental designs;
CO2	Analyze data on experiments with incomplete blocks;
CO3	Analyze asymmetrical experiments;
CO4	Fit ANCOVA models.

Mapping Course Learning Outcomes (COs)with the POs

	3: Strong		2: Moderate		1: Weak	
Course Learning Outcomes	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6

(CO)						
CO1	2	3		2		
CO2	3	3		2	2	
CO3	3	3		2		
CO4	2	3		2	2	

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	
CO 3	Lecture using board/ assignment	
CO 4	Lecture using board/ assignment	

Main Texts

1. Montgomery D. C., (2020), Design and Analysis of Experiments, 10th Edition, Wiley, NY
2. Lawson, J. (2015), Design and Analysis of Experiments with R, Chapman and Hall/CRC

Reference Books

1. Bhuyan M. R., Fundamentals of Experimental Design, 2nd Edition, Book World Publications, Dhaka
2. Gomez K. A. & Gomez A. A., Statistical Procedures for Agricultural Research, 2nd Edition, Wiley, NY
3. Kempthorne O., The Design and Analysis of Experiment, Reprint Edition, Wiley, NY

Course Code: STA 0542 4157	Credit: 3.0	Year: 4 th	Semester: 1 st
Course Title: Sampling Techniques – II		Course Status: Theory	

Rationale of the Course: In this course, advanced sampling techniques for sample surveys are introduced. It includes non-sampling errors, two-stage sampling, multistage sampling, methods for calculating variance in complex surveys, and

sampling of unequal clusters. Thus, students can acquire knowledge to design and implement complex sample surveys.

Course Objectives: The objectives of the course are

- Acquaint students with the concepts and solid knowledge of cluster sampling, multistage sampling, double sampling, and sampling on two or more occasions,
- Make students understand of sampling and non-sampling errors and consequences of such errors,
- Foster the analytical and critical thinking ability to outline and carry out various complex surveys,
- Familiarize with large-scale surveys used in Bangladesh.

Course Contents

Introduction: Sampling with unequal probability, Horvitz-Thompson estimator and its standard error. Brewer and Durbin's methods of selection of sample of size 2. Raj, Murthy, Rao-Hartley and Cochran and Samford's methods of selection. PPS systematic selection. Estimation and standard errors. **Multi-stage sampling:** Two and three stage sampling – equal and unequal clusters. Selection of units with equal and unequal probability with or without replacement. Self-weighting estimates. **Double sampling with PPS selection:** Double sampling for stratification, ratio, regression and difference estimations, repetitive surveys. Sampling on two or more occasions. **Sampling errors and non-sampling errors:** Different methods of estimating non-sampling errors. Nonresponse, interviewer's bias, interpenetrating subsamples. Familiarity with recent sample surveys in Bangladesh. Large-scale surveys – DHS, HIES and SVRS.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Distinguish between sampling with equal and unequal probability;
CO2	Describe cluster sampling, multistage sampling, double sampling, and sampling on two or more occasions
CO3	Differentiate between sampling and non-sampling errors;
CO4	Produce appropriate estimation of population means, and totals along with their standard errors under various sampling techniques;

CO5	Design appropriate sample surveys in various social, economic, agricultural, industrial, and health sectors and thier implementation.
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Mapping Course Learning Outcomes (COs)with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2				
CO2	2	2	2			
CO3	2			2		
CO4	3	2		2		
CO5		3	3	2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ tutorial	Quiz/ Midterm Examination 1 Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 4	Lecture using board/ projectors	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Cochran W. G., (1977), Sampling Techniques, 3rd Edition, John Wiley, NY
2. Lohr S. L., (2010), Sampling: Design and Analysis, 2nd Edition, MPS Limited, A Macmillan Company, USA

Reference Books

1. Raj D., (1968), Sampling Theory, Tata McGraw Hill, Delhi
2. Islam M. N., (2005), An Introduction to Sampling Methods, 1st Edition, Book World, Dhaka.
3. Kish L., (1968), Survey Sampling, Wiley, 1st Edition, NY
4. Latest Reports of BDHS, HIES, SVRS
5. Singh D., & Chaudhary F. S., (1986), Theory and Analysis of Sample Survey Designs, John Wiley & Sons
6. Sukhatme P. V., (1984), Sampling Theories and Surveys with Applications, 3rd Edition, Iowa State University Press, USA
7. United Nations Handbook on Surveys

Course Code: STA 0542 4158	Credit: 2.0	Year: 4 th	Semester: 1 st
Course Title: Sampling Techniques – II Lab		Course Status: Lab	

Rationale of the Course: Apply acquired knowledge to complex sample surveys.

Course Objectives: The objectives of the course are

- Help the students to draw sample using double sampling, two-stage sampling and PPS sampling,
- Make the students able to estimate population totals, population means and standard errors under double sampling, two-stage sampling and PPS sampling.

Course Content: Estimates and standard errors of estimates for sample selected with unequal probabilities, Two or more stage sampling (equal and unequal size clusters), PPS sampling, double sampling, self-weighting estimates.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Perform complex sampling designs;
CO2	Compute population totals, population means and standard errors under double sampling, two-stage sampling and PPS sampling;
CO3	Find self-weighting estimates.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3	1	2		
CO2	3	2	1	1		
CO3	2			2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	
CO 3	Lecture using board/ assignment	

Main Texts

1. Cochran W. G., (1977), Sampling Techniques, 3rd Edition, John Wiley, NY
2. Lohr S. L., (2010), Sampling: Design and Analysis, 2nd Edition, MPS Limited, A Macmillan Company, USA

Reference Books

1. Raj D., (1968), Sampling Theory, Tata McGraw Hill, Delhi
2. Islam M. N., (2005), An Introduction to Sampling Methods, 1st Edition, Book World, Dhaka.
3. Kish L., (1968), Survey Sampling, Wiley, 1st Edition, NY
4. Latest Reports of BDHS, HIES, SVRS
5. Singh D., & Chaudhary F. S., (1986), Theory and Analysis of Sample Survey Designs, John Wiley & Sons
6. Sukhatme P. V., (1984), Sampling Theories and Surveys with Applications, 3rd Edition, Iowa State University Press, USA
7. United Nations Handbook on Surveys

Course Code: STA 0542 4150	Credit: 1.0	Year: 4 th	Semester: 1 st
Course Title: Presentation & Viva-voce			Course Status: Lab

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong

2: Moderate

1: Weak

Course	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill
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Learning Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		3		3	
CO2	3				3	
CO3	3				3	3
CO4	2				3	3
CO5	1		3		3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Fourth Year Second Semester Course Details

Course Code: STA 0542 4251	Credit: 3.0	Year: 4 th	Semester: 2 nd
Course Title: Multivariate Analysis		Course Status: Theory	

Rationale of the Course: Due to the complexity of most events in the real world, an investigator must gather and analyze observations on numerous variables as opposed to single variable. Data analysts' need for statistical methods to extract information from multiple dimensions data thus becomes critical and essential. Multivariate techniques based on normal theory are the main topic of this course. It equips students with the practical skills necessary to assess data and find solutions to issues involving measurements of more than one variable each with n subjects. Therefore,

students can acquire knowledge of the analysis and interpretation of multivariate techniques.

Course Objectives: The objectives of the course are

- To facilitate necessary knowledge about multivariate theory,
- To provide knowledge of statistical inference about multivariate means including hypothesis testing, confidence ellipsoid calculation and different types of confidence intervals estimation.

Course Contents

Non-central distributions: Non-central χ^2 , non-central t and non-central F distributions and their properties. **Distribution of quadratic forms:** Distribution of general quadratic form, properties, expected values, moment and moment generating function, Cochrans’ theorem. **Multivariate normal distribution:** Derivation of multivariate normal distribution, marginal, conditional, moments, moment generating functions, and characteristic function. Properties of multivariate normal distribution. **Multivariate sampling distributions:** Hotelling’s T^2 distribution, Mahalanobis D^2 distribution, Wishart distribution. Tests for covariance and correlation patterns and multivariate normality. Simulation of multivariate normal variate. **Multivariate linear models:** Multivariate linear regression, MANOVA, MANCOVA, covariance selection, conditional Gaussian distribution and conditional independence graph.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Explain the properties of non-central distributions (non-central χ^2 , t, and F distributions);
CO2	Apply the distribution of quadratic forms, including expected values and moment generating functions;
CO3	Analyze the derivation and properties of the multivariate normal distribution, including marginal and conditional distributions;
CO4	Evaluate multivariate sampling distributions and tests for covariance, correlation patterns, and multivariate normality;
CO5	Design multivariate linear models, including multivariate linear regression, MANOVA, and MANCOVA.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3			2		
CO2	3			2		
CO3	3			2		
CO4	3			2		
CO5	3			2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/projectors	Quiz/ Semester-end examination
CO 3	Lecture using board/projectors	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/tutorial	Quiz/ Semester-end examination
CO 5	Lecture using board/assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Johnson R. A. & Wichern D. W., (2015), Applied Multivariate Statistical Analysis, 6th Edition, Pearson Prentice Hall, NJ
2. Rencher A. C., Christensen F., (2012), Methods of Multivariate Analysis, 3rd Edition, John Wiley & Sons Inc, NY

Reference Books

1. Anderson T. W., An Introduction to Multivariate Analysis, Wiley and Sons, NY
2. Graybill F. A., An Introduction to Linear Statistical Models, Vol-1, 2nd Edition, McGraw Hill, NY
3. Cox & Hinkley, Theoretical Statistics, Chapman and Hall, UK

Course Code: STA 0542 4252	Credit: 2.0	Year: 4 th	Semester: 2 nd
Course Title: Multivariate Analysis Lab			Course Status: Lab

Rationale of the Course: Apply acquired knowledge of the analysis and interpretation of real-life multivariate data.

Course Objectives: The objectives of the course are

- To facilitate necessary skills to draw multivariate random samples,
- To acquaint students with the hypothesis testing of multivariate means,
- To develop the ability to apply multivariate linear regression model and test for goodness of fit.

Course Contents

Multivariate Normal Distribution: Simulation of multivariate normal variate. **Multivariate Sampling Distributions:** Tests of mean vectors by Hotelling's T^2 and Mahalanobis D^2 ; Tests for covariance and correlation patterns and multivariate normality. **Multivariate Linear Models:** Estimation of multivariate linear regression and construction of MANOVA.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Simulate multivariate normal variates;
CO2	Interpret tests of mean vectors using Hotelling's T^2 and Mahalanobis D^2 ;
CO3	Estimate parameters in multivariate linear regression models;
CO4	Perform MANOVA;
CO5	Assess multivariate normality through covariance and correlation patterns.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	2		3	2	
CO2	3	2		2		
CO3	3	3		2		
CO4	3	2		2		2
CO5	3	2		2		2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	
CO 3	Lecture using board/ assignment	
CO4	Lecture using board/ assignment	
CO5	Lecture using board/ assignment	

Main Text

- Johnson R. A. & Wichern D. W., (2015), Applied Multivariate Statistical Analysis, 6th Edition, Pearson Prentice Hall, NJ

Reference Books

1. Rencher A. C., Christensen F., (2012), Methods of Multivariate Analysis, 3rd Edition, John Wiley & Sons Inc, NY
- Graybill F. A., An Introduction to Linear Statistical Models, Vol-1, 2nd Edition, McGraw Hill, NY

Course Code: STA 0542 4253	Credit: 3.0	Year: 4 th	Semester: 2 nd
Course Title: Biostatistics and Epidemiology		Course Status: Theory	

Rationale of the Course: This course is designed to study survival data and its application with the help of parametric, semi-parametric and non-parametric methods. Moreover, this course also includes epidemiological concept with various models

such as logistic, Poisson regression models and linear mixed models. Thus, this course will help students to acquire knowledge to analyze data produced in biological sciences.

Course Objectives: The objectives of the course are

- Acquaint students with the concepts of Biostatistics and Epidemiology,
- Help students conceptualize basic theories in lifetime distributions, estimation of survival functions, concepts of incomplete data and estimation of survival probabilities,
- Provide students with the tools and strategies of epidemiological investigation studies.

Course Contents

Basic quantities: Concept of survival data, application and challenges of survival data in different fields, history of survival analysis and its progress, censoring: type – I, type – II and random censoring, truncation, lifetime distribution, survival function, hazard function, interrelationships, mean residual life function, median life time. **Nonparametric methods:** Kaplan–Meier (product-limit), Nelson–Aalen estimators, Life-table (or actuarial) method, Log-rank and Wilcoxon test, estimation of survival function, hazard function; reduced sample method, estimation and standard error. **Parametric and semi-parametric methods:** Construction of likelihood function for censored and complete data, inference procedure for exponential and Weibull distributions under complete and censored data. Basic concept of Cox proportional hazard model. **Epidemiologic concept:** Overview of important historical development of epidemiology, basic terminology and principles used in epidemiology. Sources of data of community health: census, vital statistics and morbidity data. Study designs: case-control, cohort, prospective, retrospective, longitudinal studies. Basic concept of causal inference. **Measure of effect and measures of association:** Incidence, prevalence, sensitivity and specificity. ROC curve. Effect measure, measures of association, standard measures, prevalence ratio, relative risk, attributable risk, odds ratio, standard errors of estimates for different types studies. **Models:** Correlated proportion, McNemar test, logistic and Poisson regression models, correlated data, basic concepts of linear mixed models.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain basic concepts of Biostatistics and Epidemiology;
CO2	Describe methods and analytical tools for survival data;
CO3	Illustrate several epidemiological studies with layouts;
CO4	Analyze survival data in different fields, especially medical and engineering sectors;
CO5	Analyze data produced in life sciences and epidemiological studies.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3				
CO2	3	2	3			
CO3		3	3			
CO4		2	3	2		
CO5		2	3	2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ tutorial	Quiz/ Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group)

		Semester-end examination
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Main Texts

1. Kleinbaum D. G., *et al* (1982), Epidemiologic Research: Principles and Quantitative Methods, John Wiley & Sons, USA
2. Rothman K. J., (2012), Epidemiology: An Introduction, 2nd Edition, Oxford University Press, UK
3. Klein J. P. & Moeschberger M. L., (2003), Survival Analysis – Techniques for Censored and Truncated data, 2nd Edition, Springer-Verlang, New York

Reference Books

4. Woodward M., (2013). Epidemiology: study design and data analysis. CRC press.
5. Bonita R. *et al*, (2006), Basic Epidemiology, WHO
6. Collett D., (2023), Modelling Survival Data in Medical Research, 4th Edition, Chapman and Hall, Florida
7. Cox D. R. & Oakes D., (1984), Analysis of Survival Data, Reprint Edition, Chapman & Hall/CRC Press, NY
8. Elandt-Jhonson R. C. & Jhonson N. L., (1999), Survival Models and Data Analysis, Wiley Inter Science, USA
1. Lawless J. F., (2002), Statistical Models and Methods for Lifetime Data, 2nd Edition, John Wiley & Sons, USA
9. Kalbfleisch J. D. & Prentice R. L., (2011), The Statistical Analysis of Failure Time Data, 2nd Edition, John Wiley & Sons, USA
10. Kleinbaum D. G. & Klein M., (2005), Survival Analysis: A Self-Learning Text, 3rd Edition, Springer-Verlang, NewYork
11. Rothman K. J. & Greenland S., (2012), Modern Epidemiology, 3rd Edition, Lippincott Williams and Wilkins, USA
12. Verbeke G. & Molenberghs G., (2000), Linear Mixed Models for Longitudinal Data, Springer-Verlag, NewYork

Course Code: STA 0542 4254	Credit: 2.0	Year: 4 th	Semester: 2 nd
Course Title: Biostatistics and Epidemiology Lab			Course Status: Lab

Rationale of the Course: Apply acquired knowledge to analyze data produced in life sciences and epidemiological studies.

Course Objectives: The objectives of the course are

- Help students apply lifetime distributions, estimate survival functions and calculate survival probabilities,
- Provide students necessary skills to estimate various epidemiological measures.

Course Contents

Estimation of survival probabilities using non-parametric methods for complete and censored cases. Identification of parametric models for survival data, estimation of parameters and hypothesis testing for exponential and Weibull distribution with complete and censored samples. Computation of incidence, prevalence, sensitivity and specificity. Measures of association, estimation of relative risk, attributable risk and odds ratio. Computation of standard errors of estimates for different types of epidemiological studies. Application of correlated proportion, McNemar test, logistic regression model and linear mixed models.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Analyze survival data using computer software;
CO2	Analyze epidemiological data with proper interpretation;
CO3	Apply epidemiological measures as well as linear mixed models for correlated data.

Mapping Course Learning Outcomes (COs)with the POs

Course Learning Outcomes (CO)	3: Strong		2: Moderate		1: Weak	
	Fundamental Skill		Social Skill		Thinking Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		2	3	3	2	
CO2		2	3	3	2	
CO3		3	3	3	2	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	
CO 3	Lecture using board/ assignment	

Main Texts

1. Klein J. P. & Moeschberger M. L., (1997), Survival Analysis – Techniques for Censored and Truncated data, Springer-Verlang, New York
2. Lawless J. F., (2002), Statistical Models and Methods for Lifetime Data, 2nd Edition, John Wiley & Sons, USA
3. Rothman K. J., (2012), Epidemiology: An Introduction, 2nd Edition, Oxford University Press, UK

Reference Books

1. Bonita R. *et al.*, (2006), Basic Epidemiology, WHO
2. Collett D., (2023), Modelling Survival Data in Medical Research, 4th Edition, Chapman and Hall, Florida
3. Cox D. R. & Oakes D., (1984), Analysis of Survival Data, Reprint Edition, Chapman & Hall/CRC Press, NY
4. Elandt-Jhonson R. C. & Jhonson N. L., (1999), Survival Models and Data Analysis, Wiley Inter Science, USA
5. Kalbfleisch J. D. & Prentice R. L., (2011), The Statistical Analysis of Failure Time Data, 2nd Edition, John Wiley & Sons, USA
6. Kleinbaum D. G., *et al.*, (1982), Epidemiologic Research: Principles and Quantitative Methods, John Wiley & Sons, USA
7. Kleinbaum D. G. & Klein M., (2005), Survival Analysis: A Self-Learning Text, 3rd Edition, Springer-Verlang, NewYork
8. Pocock S. J., (1985), Clinical Trials: A Practical Approach, Wiley, NY
9. Rothman K. J. & Greenland S., (2012), Modern Epidemiology, 3rd Edition, Lippincott Williams and Wilkins, USA
10. Verbeke G. & Molenberghs G., (2000)LinearMixedModelsforLongitudinalData, Springer-Verlag, NewYork

Course Code: STA 0542 4255	Credit: 2.0	Year: 4 th	Semester: 2 nd
Course Title: Generalized Linear Models		Course Status: Theory	

Rationale of the Course:

In this course, many statistical models for the analysis of quantitative and qualitative data of the kinds typically found in research are covered. In particular, students acquire knowledge on models those follows exponential family of distributions.

Course Objectives: The objectives of the course are

- To acquaint students with the concepts of model fitting and adequacy checking,
- To facilitate necessary knowledge on sampling distribution of score statistics, maximum likelihood estimators, deviance, and likelihood ratio statistics,
- To provide knowledge of exponential family of distributions, general and generalized linear models, and various link functions,
- To foster the analytical and critical thinking ability for analyzing data that come from normal as well as other distributions.

Course Contents

Introduction: Introduction to the concepts of modeling. **Model fitting:** Examples, some principles of statistical modeling (exploratory data analysis), model formulation, parameter estimation, residuals and model checking), estimation and tests based on specific problems. Sampling distribution for score statistics, MLEs, deviance; log-likelihood ratio statistic. **Exponential family:** Bernoulli, binomial, Poisson, exponential, gamma, normal, *etc.* Properties of distributions in the exponential family, expected value, variance, expected value and variance of score statistic, examples for various distributions. Components of generalized linear models – random, systematic and link functions, Poisson regression. Maximum likelihood estimation using chain rules, random component, mean and variance of the outcome variable, variance function, dispersion parameter, applications. **Systematic component and link function:** Identity link, logit link, log link, parameter estimation. Score function and information matrix, estimation using the method of scoring, iteratively reweighted least squares. **Inference procedures:** Deviance for

logit, identity, log link functions, scaled deviance, sampling distributions, hypothesis testing. Generalized Pearson chi-square statistic, residuals for GLM, Pearson residual, Anscombe residuals. Logit link function, iteratively reweighted least squares, tests; nominal and ordinal logistic regression. **Goodness of fit tests:** Hosmer-Lemeshow test, pseudo-R square, AIC and BIC. **Quasi-likelihood:** Construction of quasi-likelihood for correlated outcomes, parameter estimation, variance-covariance of estimators, estimation of variance function. Quasi-likelihood estimating equations, comparison between likelihood and quasi-likelihood methods. **Modeling for repeated measure data:** GEE for repeated measures data, repeated measures models for normal data (e.g. Linear Mixed Effect Models), repeated measures models for non-normal data (e.g. Generalized Linear Mixed Effect Models), working correlation matrix, robust variance estimation or information sandwich estimator, hypothesis testing.

Course Learning Outcomes (COs): By the end of the course, students will be expected to -

CO1	Derive sampling distributions of score statistics, MLEs, deviance, log-likelihood ratio statistics;
CO2	Compare and contrast between general and generalized linear models;
CO3	Carry out tests of hypotheses related to GLMs;
CO4	Fit GLMs along with model diagnostics;
CO5	Discriminate quasi-likelihood and likelihood function along with its application for fitting models.

Mapping Course Learning Outcomes (COs)with the POs

Course Learning Outcomes (CO)	3: Strong		2: Moderate		1: Weak	
	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill	PO 5	PO 6
	PO 1	PO 2	PO 3	PO 4		
CO1	3	2		2	2	
CO2	3	2		2	2	
CO3	3	3				
CO4	3	2		2	2	

CO5	3	2		2		
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Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ tutorial	Quiz/ Midterm Examination 1; Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 3	Lecture using board/ tutorial	Quiz/ Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2; Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Text

- Dobson A. J. & Barnett A. G., (2008), An Introduction to Generalized Linear Models, 3rd Edition, Chapman and Hall, Florida

Reference Books

- Agresti A., Categorical Data Analysis, 3rd Edition, Wiley, NY
- Hosmer D. W., & Lemeshow S., Applied Logistic Regression, 2nd Edition, Wiley, NY
- McCullagh P. & Nelder J. A., Generalized Linear Models, 2nd Edition, Chapman and Hall, UK
- Molenberghs G. & Verbeke G., (2005), Models for Discrete Longitudinal Data, Springer
- Verbeke G. & Molenberghs G., (2000), Linear Mixed Models for Longitudinal Data, Springer

Course Code: STA 0542 4261	Credit: 2.0	Year: 4 th	Semester: 2 nd
Course Title: Introduction to Data Science		Course Status: Theory	

Rationale of the Course: The main computational principles, methods, and procedures for organizing, storing, and evaluating massive amounts of data of diverse kinds and frequencies will be covered in this course. In particular, this course will provide how statistical models can be used in computer systems to examine large data sets and enable computers to carry out activities that are beyond the scope of traditional computer science approaches. Therefore, this course needs a basic understanding of computer programming.

Course Objectives: The objectives of the course are

- To familiarize students with data Science including its features and difficulties, and to provide them with the necessary tools for organizing and interpreting data.
- To assist students in comprehending the uses of Big data in various areas.
- To prepare the students in dealing with big data in real life.

Course Contents

Data Science Basics: Data, information, and knowledge. Concept of data science. Data science objectives, data science process and data science tasks. Importance and applications of data science. Data science tools, techniques and best practice. Skills for data science. Data science methodology. Ethics, bias and privacy in data science. Related to other fields- data science and statistics, data science and mathematics, data science and business analytics, health and biomedical data science, data science and information science. Data science career.

Data, Sources, Generation and Storage: Data attributes, data-storage formats, data sources, data generation, data management techniques for data collection and storage, data cloud services. Data supply chain.

Dataset Preprocessing and Data Preparation: Data cleaning, feature encoding, missing value processing, data formatting, data reduction, data transformation, data normalization, data integration, data discretization, outlier detection. Exploratory data analysis and data visualization.

Concepts of Predictive Modelling and Machine Learning: Supervised learning, unsupervised learning, semi-supervised learning and reinforcement learning.

Regression- linear and logistic regression. Classification- K-nearest neighbors, decision tree, random forest, support vector machine and naive Bayes classifiers. Artificial neural networks. Cluster analysis. Feature selection and model evaluation. Ensemble learning. Association-rule mining. Deep learning. Natural Language Processing.

Big Data Analysis: Characteristics of Big Data. Types of Big Data. Big Data analysis problems. Big Data analytics techniques. Big Data analytics platforms. Big Data analytics architecture. Tools and systems for Big Data analytics. Active challenges of Big Data analysis.

Data Science Project: Hands-on Data Science Project with R, Python and SQL. Individual/group project designed by the course teacher which can be counted as the class evaluation/assignments.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Explain basic data science tools and techniques;
CO2	Design various statistical machine learning algorithms in real-world applications;
CO3	Handle big data;
CO4	Work on different areas of data science projects using statistical softwares in real life.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3			3	3	3
CO2	3			3	3	3
CO3	3			3	3	3
CO4	3			3	3	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/ projectors	Quiz/ Midterm Examination 1; Semester-end examination
CO2	Lecture using board/ projectors	Quiz; Semester-end examination
CO3	Lecture using board/ projectors	Quiz/ Midterm Examination 2; Semester-end examination
CO4	Statistical Softwares/ projectors	Individual/group Project

Text Books

1. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier.
2. Ou, G., Zhu, Z., Dong, B., & Weinan, E. (2023). Introduction to Data Science. World Scientific.

Reference Books

1. Shah, C. (2020). A hands-on introduction to data science. Cambridge University Press.
2. Wagh, S. J., Bhende, M. S., & Thakare, A. D. (2021). Fundamentals of data science. Chapman and Hall/CRC Press.
3. Burns, S. (2019). Fundamentals of Data Science: Take the First Step to Become a Data Scientist.

Course Code: STA 0542 4257	Credit: 2.0	Year: 4 th	Semester: 2 nd
Course Title: Research Methodology		Course Status: Theory	

Rationale of the Course: To find answers and learn new things is the goal of research. The main instrument employed in almost every branch of science to extend the boundaries of understanding is research. The theoretical foundations of conducting research, from problem formulation to report writing, are included in the

research technique component. Students will acquire in depth knowledge of research methodology for the purposes of describing an event, discovering the relationship between phenomena, or making predictions about future events.

Course Objectives: The objectives of the course are

- Acquaint students with basic concepts of research and its methodologies,
- Provide knowledge of selecting and defining appropriate research problems,
- Facilitate necessary knowledge on writing research proposal, research report and thesis,
- Enhancing the skills on conducting research project in a group.

Course Contents

Elements of research: Concepts, definitions and scope of research. Research question, target population and study population. Research methods and methodology, research ethics, desirable qualities of research, research question, research objectives, research hypotheses, operational definition. **Research ideas:** Role of literature review. Inductive approach, deductive approach, complementary of inductive and deductive approach, wheel of science. **Research approaches and types:** Quantitative and qualitative approaches of research. Idea about various types of research under quantitative approaches according to different criteria. **Qualitative approaches:** Focus group discussion (FGD), in-depth interview (IDI), key informant interview (KII) and their guidelines and checklist. **Research process:** Conceptual, empirical and analytical phases of research. Problem identification, literature review, setting objectives and hypothesis, selection of research design and sample design, data gathering, data processing and analysis, and report writing. **Detailed study of important research designs:** Exploratory studies – secondary data analysis, experience survey, pilot study, case study, focus group discussion. Descriptive studies – cross-sectional, longitudinal, trend, panel study, baseline study, impact assessment, feasibility study designs. Causal studies – comparative, case-control, cohort. **Experimental studies:** Concepts of randomization, grouping, matching, advantages and disadvantages over non-experimental designs, validity in experimentation. Study on experimental research designs – pre-experimental, true-experimental and quasi-experimental. **Sample design:** Choice of correct sampling methods and sample size determination. **Data gathering:** Quantitative data collection techniques – interview method, mail method, telephone surveys; qualitative methods of data collection

observation, in-depth interviews, case studies, focus group discussions. Key informant interview, participatory rural appraisal. **Questionnaire design and construction:** Types of questions, framing of questions, sequencing questions, construction of a model questionnaire, question wording, guidelines for avoiding poor question wording. **Idea about planning and implementation of a research study:** Time and financial budgeting, logistics of data collection, recruitment and training of the enumerators, field work supervision and quality control of data. **Data processing and analysis:** Editing, coding, data entry, validation check, imputation of variables, tabulation plan, data analysis. **Reliability and validity in measurements:** Initiation of model building, measurement error, test for sound measurement, reliability and its measurements, validity and its types, measurements of validity; stability of the model over the population, construction of measurements scales. **Report writing:** Types of reports, design and structure of reports, introductory section, main body, concluding section, tables and graphical presentations, references and bibliography. **Research proposal:** Request for proposal, term of reference, components of a proposal, evaluation of proposal.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Define research question, research process, different types of studies, sampling design, questionnaire, ethical issues;
CO2	Extract relevant informations from the literature to develop methodological aspetcs for a research question;
CO3	Create a good research proposal;
CO4	Conduct research project independently along with report writing
CO5	Collaborate a research to benefit the stakeholders.

Mapping Course Learning Outcomes (COs)with the POs

Course Learning Outcomes (CO)	3: Strong		2: Moderate		1: Weak	
	Fundamental Skill		Social Skill		Thinking Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3				
CO2		3		2	2	
CO3		2		3	3	

CO4		2		2	3	2
CO5			3		2	2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ tutorial	Quiz/ Midterm Examination 1 Semester-end examination
CO 2	Lecture using board/ tutorial	Quiz/ Semester-end examination
CO 3	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Kothari C. R., (2013), Research Methodology - Methods and Techniques, 3rd Edition, New Age, New Delhi
2. Trochim W. M. K., Research Methods – Knowledge Base, <https://www.socialresearchmethods.net/kb/>
3. Akand M. A. S., (2019), Research Methodology – A Complete Direction for Learners, 2nd Edition, Akanda & Sons, Academic Publishers, Dhaka

Reference Books

1. Islam M. N., An Introduction to Research Methods, Mullick & Brothers, Dhaka
2. Malhotra N. K., Marketing Research – An Applied Orientation, 5th Edition, Prentice Hall of India, New Delhi
3. Palys T., Research Decisions – Quantitative and Qualitative Perspectives, 2nd Edition, International Thomson Publishing

Course Code: STA 0542 4258	Credit: 3.0	Year: 4 th	Semester: 2 nd
Course Title: Research Project			Course Status: Capstone

Rationale of the Course: Traditional theory and lab courses cannot fully provide a student the in-depth knowledge and skills required to be a subject expert. In order to learn the application of a study subject as an expert in solving real-life problem and to acquire transferable and professional skills, it is essential for an undergraduate student to undertake research projects.

Course Objectives: The objectives of the course are

- To facilitate necessary skills about hands-on experience of conducting a research project,
- To foster the analytical and critical thinking ability to apply statistical methods appropriately.

Course Contents

Students will be in consultation with assigned teachers to select project topics.

Evaluation: Every student will have to submit research report to the department through assigned teachers. The reports will be examined by the assigned teachers against 30% marks, by another examiner against 30% marks. The oral presentation of reports for examinations by the examination committee will carry another 40% marks. Results will be processed by the examination committee.

Reference Books

Recommended readings and books referred by the supervisors of the research project.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Write an appropriate research proposal including design a research project;
CO2	Develop suitable questionnaire for collecting necessary primary data;
CO3	Perform data cleaning and management;
CO4	Apply analytical tools, write a research report and disseminate research findings by an effective oral presentation.

Mapping Course Learning Outcomes (COs) with the POs

Course Learning Outcomes (CO)	3: Strong		2: Moderate		1: Weak	
	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3		2	3	2
CO2	2	3	2	2	2	
CO3		2		3	2	
CO4		3		3	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Project	Semester-end examination
CO 2	Project	Semester-end examination
CO 3	Project	Semester-end examination
CO 4	Project	Semester-end examination
CO 5	Project	Semester-end examination

Optional Course Details

Course Code: STA 0542 4259	Credit: 4.0	Year: 4 th	Semester: 2 nd
Course Title: Comprehensive		Course Status: Optional/Elective	

Rationale of the Course: It is essential for the students to bear always the fundamental concepts to handle the academic problems in any situation. Therefore, this course is designed as an additional option in the final semester with a view to revive foundation of the students on basic statistical tools and techniques for collecting and analyzing data, and interpretation of the findings.

Course Objectives: The objectives of the course are

- Make the students capable to understand the statistical tools and techniques for data collection and analysis,

- Assist the students to apply statistical techniques in real field.

Course Content

Introductory Concepts: Population, Parameter, Sample, Statistic, Estimator, Estimate, Variable, Attribute, Measurements Scales, Data, Meaning of Statistics, Descriptive Statistics, Inferential Statistics. **Collection of data:** Primary data, Secondary data, **Presentation of data:** Statistical table, Chart, Frequency distribution. **Averages / Measures of central tendency:** Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode. Merits and Limitations. **Dispersion:** Meaning, Absolute and relative measures: Range, Mean deviation, Standard deviation, Coefficient of variation. **Shape characteristics of distribution:** Skewness and Kurtosis. **Probability:** Sets and their properties, Random Experiment, Sample space, Event, Classical and Statistical definitions of probability, Additive and multiplicative laws of probability, Conditional probability, Baye's theorem. Problems. **Concept of random variable:** Probability distribution, Probability function, Distribution function, Mathematical expectation and variance. Problems. Discrete and continuous probability distributions: Bernoulli, Binomial, Poisson, Negative binomial, Geometric, Hyper geometric, Normal, Gamma, Exponential. Problems. **Sampling distribution:** Concepts, Methods of finding sampling distribution of statistic. t-statistic, F-statistic, χ^2 Statistic and their distributions. Applications. **Point estimations and interval estimation:** Methods of obtaining point estimator, Properties of a good point estimator. Maximum likelihood estimator, moment estimator, Bayes estimator. **Test of hypothesis:** Concept, Null and alternative hypotheses, Type I error, Type II error, Critical region, Level of significance (α) and p-value, Test statistics, Some parametric and non-parametric tests. **Sample Survey:** Census, Sampling, sampling error and non-sampling error, Probability sampling and non-probability sampling. Simple random sampling (SRS), Methods of drawing sample under SRS, Problem. **Experimental design:** Treatment, Block, Experimental unit, Experimental error. Principles of design, Analysis of variance, Completely randomized design, Randomized block design and Latin squares design.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Gather widespread knowledge on descriptive statistical tools, probability, probability distributions, and sampling distributions;
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CO2	Layout experimental design, select appropriate sampling techniques and determination of sample size in real situation;
CO3	Estimate the parameters using point estimation along with construction of interval estimation;
CO4	Develop a regression model including its prediction;
CO5	Perform parametric and non-parametric tests of hypotheses.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong

2: Moderate

1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3		2		
CO2	3	3		2		
CO3	3	3				
CO4	3	3		2		
CO5	3	3				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning & Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 2	Lecture using board/ tutorial	Quiz/ Semester-end examination
CO 3	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group)

		Semester-end examination
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Reference Books

1. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Revised Edition, Sultan Chand and Sons, New Delhi, India
2. Islam M. N., (2006), Introduction to Statistics and Probability, 3rd Edition, Book World, Dhaka
3. Mostafa, M. G., (1989), Methods of Statistics, Karim press and publication, Dhaka Bangladesh
4. Ross S. M., (2010), Introductory Statistics, 3rd Edition, Academic Press, USA
5. Ross S. M., (2018), A First Course in Probability, 9th Edition, Academic Press, NY
6. Roy M. K., (2011), Fundamentals of Probability and Probability Distributions, 8th Edition, ROMAX Publications, Chittagong

Course Code: STA 0542 4250	Credit: 1.0	Year: 4 th	Semester: 2 nd
Course Title: Presentation & Viva-voce		Course Status: Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		3		3	
CO2	3		3		3	
CO3	3				3	3
CO4	2				3	3
CO5	1		3		3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group	Semester-end oral examination
CO 2		
CO 3		
CO 4		

CO 5	study	
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Part D

20. Grading/Evaluation: According to the ordinance of the university

1) Grading Scale and

2) Grades:

Letter Grade and corresponding Grade-Point for a course will be awarded from the roundup marks of individual courses as follows:

Numerical Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	C-	2.00
Less than 40%	F	0.00

3) Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)

GPA:

Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses completed by a student in a semester.

CGPA:

Cumulative Grade Point Average (CGPA) of major and second major degrees will be calculated separately by the weighted average of all courses of the previous semesters along with that of the current/present semester. For the calculation of the final CGPA of clearing graduates, if the third digit after the decimal point is nonzero then its previous, that is, the second digit will be incremented by one. A student, if applicable, will also receive a separate CGPA for her/his Second Major courses.

F Grades:

A student will be given an “F” grade if s/he fails or remains absent in the final examination of a registered course. If a student obtains an “F” grade, her/his grade will not be counted for GPA and s/he will have to repeat the course. An “F” grade will be in her/his record, and s/he will not be eligible for distinction, award, and scholarship of the university.

4) Course Improvement

A student will be allowed only once to improve maximum of 2 (two) theory courses for which s/he has obtained a B- grade or less in the previous level by registering in the semesters of the immediate next level. Such course grade improvement opportunity shall be given only for 100- 300 level courses. If the course grade does not improve then the previous course grade will sustain in grade count. In the case of the course grade improvement, this will be cited/noted in the concerned transcripts beside the grade count as “Improvement.”

5) Incomplete courses

If a student has an incomplete course(s), s/he has to register such an incomplete course(s) from preceding semesters before registering courses from current or successive semesters. If an incomplete course is not available or offered in the running semesters, the student shall take such course(s) when it is available or offered.

6) Course Withdrawal

A student can withdraw a course by a written application to the Controller of Examinations through the Head of the discipline two weeks before the examination start. The Controller of Examinations will send the revised registration list to the disciplines before the commencement of semester final examination. There will be no record of the course in transcript if the course is withdrawn.

7) Repetition

If a student has to repeat a failed or incomplete course and that course is not available/offered any more, the discipline may allow him/her to take an equivalent course from the current curriculum. For clearing graduates, if any incomplete course is not available/offered in the running semester, the discipline may suggest a suitable/equivalent course to complete the credit requirement so required for the degree.

8) Break in study:

In very special cases, if a student does not register and remains absent continuously for 2-4 (two to four) semesters within her/his 12/14 semesters of 4/5 years’ program, then s/he may apply for readmission as an irregular student. Her/his application will be considered only once provided that s/he has already completed 80% or more of the credits for which s/he was supposed to register and sit in the examination before the beginning of her/his break of study. The concerned discipline will analyze the application and send its well-judged recommendation to the Dean within the 1st month of the running semester. The Academic council, based on the recommendation of the discipline and the opinion of the Dean, may allow the applicant for admission as an irregular student. Such student has to complete the required credits within her/his remaining number of semesters. In the certificate, grade sheet and transcript of all irregular students, the word “irregular” will be mentioned.